Risks of Chloropicrin Use to Federally Listed Threatened California Red Legged Frog
(*Rana aurora draytonii*)

Pesticide Effects Determination

Environmental Fate and Effects Division
Office of Pesticide Programs
Washington, D.C. 20460

July 19, 2007

Primary Authors
Faruque Khan, Environmental Scientist
James Felkel, Wildlife Biologist

Secondary Review
Jean Holmes, Risk Assessment Process Leader
M. A. Ruhman, Agronomist

Branch Chief, Environmental Risk Branch 5
Mah Shamim

TABLE OF CONTENTS

ATTACHMENTS

1.0 Executive Summary

The purpose of this endangered species assessment is to evaluate potential direct and indirect effects on individuals of the federally threatened California red-legged frog *(Rana aurora draytonii*) (CRLF) arising from FIFRA regulatory actions regarding the pre-plant soil incorporated use of the fumigant chloropicrin on all agricultural and certain non- agricultural sites. In addition, this assessment evaluates whether these actions can be expected to result in the destruction or adverse modification of the species' critical habitat.

The CRLF is endemic to California and Baja California (Mexico) and historically inhabited 46 counties in California including the Central Valley and both coastal and interior mountain ranges (USFWS 1996). Its range has been reduced by about 70%, and the species currently resides in 22 counties in California (USFWS 1996).

Chloropicrin, a pre-plant soil fumigant is used in controlling a broad range of soil pathogens. It is a clear, colorless, nonflammable oily liquid with strong, sharp, highly irritating odor and is a strong lacrimator (tear-producer). Chloropicrin's specific mode of action is not understood, but it is a strong irritant that is very toxic to all biological systems, affecting body surfaces and interfering with the respiratory system and the cellular transport of oxygen. Chloropicrin is registered for use on all crops and on many non-crop areas. It is typically applied once per growing season through soil injection or drip irrigation to fumigate the upper six to twelve inches of soil a number of weeks prior to planting.

The high vapor pressure (23.8 mm Hg @ 25°C), high Henry's Law Constant (2.05 X 10^{-3} atm M^3/mole), and low soil adsorption coefficient (K_{oc} 36.05 L kg^{-1}) on soil of chloropicrin suggest that volatilization is the most important environmental route of dissipation. Direct photolytic degradation ($t_{1/2}$ <8 hrs) of chloropicrin is the primary route of dissipation in the atmosphere. Environmental fate and transport models were used to estimate high-end exposure values expected to occur in the CRLF action area as a result of agricultural and non-agricultural chloropicrin use in accordance with label directions. Modeled concentrations provide estimates of exposure which are intended to represent chloropicrin concentrations transported with runoff water to potential CRLF aquatic habitat.

Assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF, as well as indirect effects, such as reduction of the prey base and/or modification of its habitat. In addition, potential destruction and/or adverse modification of critical habitat is assessed by evaluating potential effects to PCEs, which are components of the habitat areas that provide essential life cycle needs of the CRLF.

Risk quotients (RQs) are derived as quantitative estimates of potential risk. RQs are compared to the Agency's levels of concern (LOCs) to identify instances where chloropicrin use within the action area has the potential to adversely affect the CRLF via direct toxicity to the frogs (aquatic and terrestrial phases) or indirectly based on direct effects to their food supply or habitat.

The best available data suggest that chloropicrin is likely to adversely affect the CRLF due to the potential for direct toxicity to aquatic and terrestrial phases of the frog, as well as the potential for indirect effects to food supply, habitat and designated Critical Habitat. A summary of the risk conclusions and effects determination is presented in Tables 1.1 and 1.2. Further information on the results of the effects determination is included as part of the Risk Description in Section 5.2. Based on these results, a formal consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act should be initiated to seek concurrence with the LAA determinations and to determine whether there are reasonable and prudent alternatives and/or measures to reduce and/or eliminate potential incidental take.

Table 1.1 Effects Determination Summary for Direct and Indirect Effects of Chloropicrin on the California Red-legged Frog

Assessment Endpoint	**Effects Determination**	**Basis**
Aquatic-Phase (Eggs, Larvae, Tadpoles, Adults)		
1. Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	Likely to Adversely Affect	Chloropicrin acute RQs exceed LOC for direct effects using acute fish data. Chronic data are not available. There is widespread overlap of potential chloropicrin use with watersheds of the CRLF.
2. Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.* freshwater fish and invertebrates, non-vascular plants)	Likely to Adversely Affect	Chloropicrin acute RQs exceed LOCs for freshwater fish and aquatic invertebrates. Chronic data are not available. There is widespread overlap of potential chloropicrin use with watersheds of the CRLF.
3. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, and/or primary productivity (*i.e.*, aquatic plant community)	Likely to Adversely Affect[1]	Although data adequate for RQs are not available, chloropicrin is a broad spectrum toxicant intended to kill many plants on-site. Modeling shows the potential for aquatic exposure and therefore aquatic non-target plants may be at risk.
4. Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	Likely to Adversely Affect[1]	Although data adequate for RQs are not available, chloropicrin is a broad spectrum toxicant intended to kill many plants on-site. Modeling shows the potential for for both aquatic exposure (e.g., from runoff) and terrestrial exposure from off-gassing and therefore riparian non-target plants may be at risk.
Terrestrial Phase (Juveniles and adults)		
5. Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	Likely to Adversely Affect	Choropicrin exceeds an equivalent LOC for acute inhalation (resulting from off-gassing), based on available mammal data. There is potential for widespread chloropicrin use in the vicinity of upland and dispersal areas of the CRLF.

Table 1.1 Effects Determination Summary for Direct and Indirect Effects of Chloropicrin on the California Red-legged Frog

Assessment Endpoint	Effects Determination	Basis
6. Survival, growth, and reproduction of CRLF individuals via effects on prey (*i.e.,* terrestrial invertebrates, small terrestrial vertebrates, including mammals and terrestrial phase amphibians)	Likely to Adversely Affect	Choropicrin exceeds an equivalent LOC for small vertebrate prey for acute inhalation (resulting from off-gassing), based on available mammal data. Given that chloropicrin is intended to control many terrestrial invertebrates on the application sites, it may also have an indirect effect on the CRLF via an impact to terrestrial invertebrates used as prey by the CRLF. There is potential for widespread chloropicrin use in the vicinity of upland and dispersal areas of the CRLF.
7. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.,* riparian vegetation)	Likely to Adversely Affect[1]	Although data adequate for RQs are not available, chloropicrin is a broad spectrum toxicant intended to kill many plants on-site. Modeling shows the potential for for terrestrial exposure from off-gassing and therefore non-target plants (including riparian vegetation) may be at risk.

[1] Relies on assumptions regarding effects to non-target plants, and a limited number of plant incidents (see Basis and Section 5.2)

Table 1.2 Effects Determination Summary for the Critical Habitat Impact Analysis

Assessment Endpoint	Effects Determination	Basis
Aquatic Phase PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)		
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	Habitat Modification[1]	Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts to aquatic and terrestrial plants that comprise these habitats.
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source[2].	Habitat Modification [1]	Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts to aquatic and terrestrial plants that comprise these habitats.
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	Habitat Modification	Fish and aquatic invertebrate acute RQs exceed LOCs.
Reduction and/or modification of aquatic-based food sources for pre-	Habitat Modification[1]	Given that chloropicrin is intended to control many plants on the application

Table 1.2 Effects Determination Summary for the Critical Habitat Impact Analysis

Assessment Endpoint	Effects Determination	Basis
Aquatic Phase PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)		
metamorphs (*e.g.,* algae)		sites, and modeling shows the potential for chloropicrin to get to water bodies, there may also be the potential for impacts to aquatic plants that comprise these habitats.
Terrestrial Phase PCEs (Upland Habitat and Dispersal Habitat)		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	Habitat Modification[1]	Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts (from off-gassed chloropicrin) to terrestrial plants that comprise these habitats.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	Habitat Modification[1]	Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts (from off-gassed chloropicrin) to terrestrial plants that comprise these habitats.
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	Habitat Modification	Chloropicrin poses acute risk to prey items of the CRLF, including freshwater fish and invertebrates, small mammals, and likely terrestrial invertebrates, for example.
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	Habitat Modification	Chloropicrin poses acute risk to prey items of the CRLF, including freshwater fish and invertebrates, small mammals, and likely terrestrial invertebrates, for example.

[1] Relies on assumptions regarding effects to non-target plants, and a limited number of plant incidents (see Basis and Section 5.2)

[2] Physico-chemical water quality parameters such as salinity, pH, and hardness are not evaluated because these processes are not biologically mediated and, therefore, are not relevant to the endpoints included in this assessment.

When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (i.e., food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (i.e., attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available. Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of CRLF life stages within specific recovery units and/or designated critical habitat within the action area. This information would allow for quantitative extrapolation of the present risk assessment's predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the species.
- Quantitative information on prey base requirements for individual aquatic- and terrestrial-phase frogs. While existing information provides a preliminary picture of the types of food sources utilized by the frog, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.
- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual frogs and potential adverse modification to critical habitat.

There are substantial uncertainties concerning the direct and indirect effects of chloropicrin on the CRLF, in part due to the extremely limited data available for risk assessment. There are no studies considered fully acceptable for any taxonomic group or time exposure, except for the mammal acute oral and chronic inhalation data used.

The uncertainties associated with the direct risk to terrestrial-phase CRLF from chloropicrin use are mainly focused on the extent and effect of exposure via inhalation. There is some uncertainty with the mammal acute inhalation toxicity (Acceptable/Non-guideline; see Section 6: Uncertainties). Avian acute and sub-chronic/chronic inhalation toxicity data are not available at all, as also noted. In addition, the lack of avian acute oral data prevents an extrapolated estimation of inhalation toxicity based on mammal data.

The uncertainties associated with the direct risk to aquatic-phase CRLF and indirect effects via the aquatic food supply and habitat from chloropicrin are due to uncertainties over the length of exposure to this highly volatile chemical and to uncertainties over the toxicity (resulting mainly from the volatility). However, both acute and chronic exposure are possible, in part due to repeat or continuous input to the aquatic environment. Acute and chronic toxicity data are not available for most fish and aquatic invertebrate guideline test categories. The risk assessment relies on supplemental data for freshwater fish and aquatic invertebrates.

2.0 Problem Formulation

Problem formulation provides a strategic framework for the risk assessment. By identifying the important components of the problem, it focuses the assessment on the most relevant life history stages, habitat components, chemical properties, exposure routes, and endpoints. The structure of this risk assessment is based on guidance contained in U.S. EPA's *Guidance for Ecological Risk Assessment* (U.S. EPA 1998), the Services' *Endangered Species Consultation Handbook* (USFWS/NMFS 1998) and is consistent with procedures and methodology outlined in the Overview Document (U.S. EPA 2004) and reviewed by the U.S. Fish and Wildlife Service and National Marine Fisheries Service (USFWS/NMFS 2004).

2.1 Purpose

The purpose of this endangered species assessment is to evaluate potential direct and indirect effects on individuals of the federally threatened California red-legged frog *(Rana aurora draytonii*) (CRLF) arising from FIFRA regulatory actions regarding the pre-plant soil incorporated use of the fumigant chloropicrin on all agricultural and certain non- agricultural sites. In addition, this assessment evaluates whether these actions can be expected to result in the destruction or adverse modification of the species' critical habitat. Key biological information for the CRLF is included in Section 2.5, and designated critical habitat information for the species is provided in Section 2.6 of this assessment. This ecological risk assessment has been prepared as part of the *Center for Biological Diversity (CBD) vs. EPA et al*. (Case No. 02-1580-JSW(JL)) settlement entered in the Federal District Court for the Northern District of California on October 20, 2006.

In this endangered species assessment, direct and indirect effects to the CRLF and potential adverse modification to its critical habitat are evaluated in accordance with the methods (both screening level and species-specific refinements, when appropriate) described in the Agency's Overview Document (U.S. EPA 2004). Additional California-specific aquatic exposure models were used. Use of such information is consistent with the guidance provided in the Overview Document (U.S. EPA 2004), which specifies that "the assessment process may, on a case-by-case basis, incorporate additional methods, models, and lines of evidence that EPA finds technically appropriate for risk management objectives" (Section V, page 31 of U.S. EPA 2004).

In accordance with the Overview Document, provisions of the ESA, and the Services' *Endangered Species Consultation Handbook,* the assessment of effects associated with registrations of chloropicrin are based on an action area. The action area is considered to be the area directly or indirectly affected by the federal action, as indicated by the exceedance of Agency Levels of Concern (LOCs) used to evaluate direct or indirect effects. It is acknowledged that the action area for a national-level FIFRA regulatory decision associated with a use of chloropicrin may potentially involve numerous areas throughout the United States and its Territories. However, for the purposes of this assessment, attention will be focused on relevant sections of the action area including those geographic areas associated with locations of the CRLF and its designated critical habitat within the state of California.

As part of the "effects determination," one of the following three conclusions will be reached regarding the potential for registration of chloropicrin at the use sites described in this document to affect CRLF individuals and/or result in the destruction or adverse modification of designated CRLF critical habitat:

- "No effect";
- "May affect, but not likely to adversely affect"; or
- "May affect and likely to adversely affect".

Critical habitat identifies specific areas that have the physical and biological features, (known as primary constituent elements or PCEs) essential to the conservation of the listed species. The PCEs for CRLFs are aquatic and upland areas where suitable breeding and non-breeding aquatic habitat is located, interspersed with upland foraging and dispersal habitat (Section 2.6).

If the results of initial screening-level assessment methods show no direct or indirect effects (no LOC exceedances) upon individual CRLFs or upon the PCEs of the species' designated critical habitat, a "no effect" determination could be made for the FIFRA regulatory action regarding chloropicrin as it relates to this species and its designated critical habitat, if there was a complete database (and no other information indicates a potential for a "may effect"). If, however, direct or indirect effects to individual CRLFs are anticipated and/or effects may impact the PCEs of the CRLF's designated critical habitat, a preliminary "may affect" determination is made for the FIFRA regulatory action regarding chloropicrin.

If a determination is made that use of chloropicrin within the action area(s) associated with the CRLF "may affect" this species and/or its designated critical habitat, additional information is considered to refine the potential for exposure and for effects to the CRLF and other taxonomic groups upon which these species depend (e.g.., aquatic and terrestrial vertebrates and invertebrates, aquatic plants, riparian vegetation, etc.). Additional information, including spatial analysis (to determine the geographical proximity of CRLF habitat and chloropicrin use sites) and further evaluation of the potential impact of chloropicrin on the PCEs is also used to determine whether destruction or adverse modification to designated critical habitat may occur. Based on the refined information, the Agency uses the best available information to distinguish those actions that "may affect, but are not likely to adversely affect" from those actions that "may affect and are likely to adversely affect" the CRLF and/or the PCEs of its designated critical habitat. This information is presented as part of the Risk Characterization in Section 5 of this document.

The Agency believes that the analysis of direct and indirect effects to listed species provides the basis for an analysis of potential effects on the designated critical habitat. Because chloropicrin is expected to directly impact living organisms within the action area (defined in Section 2.7), critical habitat analysis for chloropicrin is limited in a practical sense to those PCEs of critical habitat that are biological or that can be reasonably linked to biologically mediated processes (i.e., the biological resource requirements for the listed species associated with the critical habitat or important physical aspects of the habitat that may be reasonably influenced through biological processes). Activities that may destroy or adversely modify critical habitat are those that alter the PCEs and appreciably diminish the value of the habitat. Evaluation of actions related to use of chloropicrin that may alter the PCEs of the CRLF's critical habitat form the basis of the critical habitat impact analysis. Actions that may affect the CRLF's designated critical habitat have been identified by the Services and are discussed further in Section 2.6.

2.2 Scope

The end result of the EPA pesticide registration process (the FIFRA regulatory action) is an approved product label. The label is a legal document that stipulates how and where a given pesticide may be used. Product labels (also known as end-use labels) describe the formulation type (e.g., liquid or granular), acceptable methods of application, approved use sites, and any restrictions on how applications may be conducted. Thus, the use or potential use of chloropicrin in accordance with the approved product labels for California is "the action" being assessed.

Chloropicrin is a fumigant registered for pre-plant use on any agricultural site and many non-agricultural sites in California. It can be used alone or in products formulated in combination with other fumigants to broaden its spectrum. In these combination end-use products, the percent active ingredient for chloropicrin can range from 20 to 55% when combined with methyl bromide and from 15 to 60% when combined with 1,3-Dichloropene, for example. Chloropicrin is typically applied once per growing season through soil injection or drip irrigation to fumigate the upper six to twelve inches of soil as a liquid 14 days or more before planting. The maximum application rate is 1,076 lb ai/A, with 300 lb ai/A the maximum for drip irrigation. The product is also used as a warning agent for odorless fumigants. Individually, strawberries, tobacco, tomatoes, and peppers were the crops with the highest percentage of their overall acreage treated from 1998 to 2000.

Although current registrations of chloropicrin allow for use nationwide, this ecological risk assessment and effects determination addresses currently registered uses of chloropicrin in portions of the action area that are reasonably assumed to be biologically relevant to the CRLF and its designated critical habitat. Further discussion of the action area for the CRLF and its critical habitat is provided in Section 2.7.

The major breakdown product of chloropicrin in soil and air is carbon dioxide. Since the degradation products of chloropicrin are also volatile and transitory to CO_2, no metabolites were considered in the risk assessment.

As noted above, chloropicrin is often formulated with other fumigants to broaden the spectrum of target pest organisms controlled. The Agency does not routinely include, in its risk assessments, an evaluation of mixtures of active ingredients, either those mixtures of multiple active ingredients in product formulations or those in the applicator's tank. In the case of the product formulations of active ingredients (that is, a registered product containing more than one active ingredient), each active ingredient is subject to an individual risk assessment for regulatory decision regarding the active ingredient on a particular use site. If effects data are available for a formulated product containing more than one active ingredient, they may be used qualitatively or quantitatively in accordance with the Agency's Overview Document and the Services' Evaluation Memorandum (U.S., EPA 2004; USFWS/NMFS 2004).

Chloropicrin has registered products that contain multiple active ingredients. Analysis of the available acute oral mammalian LD50 data for multiple active ingredient products relative to the single active ingredient is provided in Appendix E. The results of this analysis show that an assessment based on the toxicity of the single active ingredient of chloropicrin is appropriate. Also, the active ingredients of fumigant multiple active ingredient products are expected to both runoff and off-gas at different rates. Thus exposure is not expected to the exact formulation itself, and assessment of chloropicrin based on single active ingredient data is considered appropriate. See Appendix E for further details.

2.3 Previous Assessments

Chloropicrin is currently being assessed under the Agency's reregistration program. A February, 2006 revised baseline assessment for chloropicrin under this program indicates the following:

> [There is a] strong presumption of acute risk to all exposed plants and animals, since chloropicrin is a broad-spectrum fumigant. It is assumed that all living organisms in the treated soil (including beneficial insects and burrowing mammals, for example) are at high risk of mortality. In addition, a wide range of terrestrial and aquatic non-target organisms off-site may also be at risk. Chloropicrin appears to pose risks to mammals and birds based on modeled air residues, exceeding an equivalent acute Level of Concern (LOC) for endangered species. It also exceeds LOCs (including acute endangered species) for fish with all modeled scenarios and for aquatic invertebrates for three of six scenarios. However, there are substantial uncertainties in estimating ecological effects of chloropicrin due to limited toxicity data and the limitations of current exposure models and crop scenarios. The PRZM model also has limited capabilities in capturing the partitions of volatile chemical in air, water and sediment. No fully acceptable toxicity data are available, except for the mammal acute oral and chronic inhalation data used, and thus uncertainty levels are high.

2.4 Stressor Source and Distribution

The source of the stressor considered in this ecological risk assessment is the sole active ingredient chloropicrin, a pre-plant fumigant used in controlling soil pathogens. Chloropicrin is a small, single-carbon organic molecule that diffuses rapidly and volatilizes from applied agricultural soils. The major source and mechanism of release of chloropicrin is volatilization from the fumigated sites. Additional transport mechanisms include runoff from pre-plant fumigated fields, and drift of volatilized chloropicrin and redeposition through precipitation in the adjacent area. The major breakdown product of chloropicrin in soil and air is carbon dioxide. Since the degradation products of chloropicrin are also volatile and transitory to CO_2, no metabolites were considered in the risk assessment. The CRLF could be exposed to both runoff and to volatilized chloropicrin and would not likely be able to avoid exposure when these occur in its habitat.

2.4.1 Environmental Fate Assessment

Chloropicrin is a clear, colorless, nonflammable oily liquid with strong, sharp, highly irritating odor and a strong lacrimator. Selected physico-chemical and environmental fate properties of chloropicrin are listed in Table 3 and 4. The high vapor pressure (23.8 mm Hg @ 25°C), high Henry's Law Constant (2.05 X 10^{-3} atm M^3/mole), and low soil adsorption coefficient (K_{oc} 36.05 L kg^{-1}) on soil of chloropicrin suggest that volatilization is the most important environmental route of dissipation. Direct photolytic degradation ($t_{1/2}$ <8 hrs) of chloropicrin is the primary route of dissipation in the atmosphere, which suggests it is not a significant threat to deplete the stratosphere ozone layer. Due to the fact that volatilization is significant and occurs rapidly, the importance of other competing processes such as leaching, biotic and abiotic degradation, and adsorption to the soil particles will certainly depend on chloropicrin emission rate from fumigated fields. This is because emission rate determines the amount of chloropicrin left for other processes and its residence time in the soil system. However, if chloropicrin remains in soil, it also degrades in soil with half-lives ranges from 4.5 to 10 days with CO_2 being the terminal breakdown product. Since chloropicrin is highly soluble in water and has low adsorption in soil, it can potentially leach into groundwater and to surface water through runoff under a flooded condition. The low octanol/water partition coefficient of chloropicrin also indicates that it is not likely to be bioconcentrated in tissues of aquatic organisms.

Table 2.1: Selected physical and chemical properties of chloropicrin

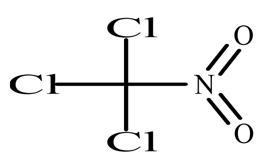
Parameter	Value	Reference
Chemical Structure		
PC Code	081501	
CAS number	76-06-2	
Common name	Chloropicrin	
SMILES Notation	N(=O)(=O)C(CL)(CL)CL	
Molecular formula	CCl_3NO_2	MRID# 43613901
Molecular weight	164.38 g/mol	MRID# 43613901
IUPAC name	trichloronitromethane	
CAS name	trichloronitromethane	
Physical State	Near colorless, oily liquid	
Melting point/range	-69.2°C	Merck Index
Boiling point/range	112°C at 757 mm Hg	Merck Index
Density	1.7 g/mL at 25 °C	Merck Index

Table 2.1: Selected physical and chemical properties of chloropicrin

Parameter	Value	Reference
Water solubility	1.612 g/L @ 25°C	MRID# 43613901
Vapor pressure	23.8 mm Hg at 25 °C	D 268927[1]
Henry's Law Constant@ 25°C	$2.05 * 10^{-3}$ atm•m^3/mole	Kawamoto and Urano, 1989
Octanol/water partition coefficient (Log K_{OW})	2.58 2.38	D 268927 Kawamoto and Urano, 1989

[1] Chloropicrin – List A Reregistration Case 0040. PC Code 081501, Product Chemistry Chapter for the Reregistration Eligibility Decision (RED)

Table 2.2. Environmental Fate Properties of Chloropicrin

Parameter	Value	Reference/Comments
Hydrolysis $t_{1/2}$	Stable at pH 5, 7, and 9	MRID# 43022401
Photolysis $t_{1/2}$ in water	1.3 days, degradates chloride, nitrate, nitrite, and CO_2	MRID# 42900201
Photolysis $t_{1/2}$ on soil	N/A	Waived
Photolysis $t_{1/2}$ in air	≤8.0 Hours	Carter et al., 1997
	20 days phosgene ($COCl_2$), nitrosyl chloride (NOCl), nitrous oxide (NO), and chlorine (Cl_2); subsequently nitrogen dioxide (NO_2) and dinitrogen tetraoxide (N_2O_4)	MRID# 05007865
Soil metabolism Aerobic $t_{1/2}$	4.5 days	Wilhelm et al., 1996
	10 days major degradate is CO_2 minor degradates (total <6%) chloronitromethane, nitromethane, and bicarbonate	MRID# 43613901
Aquatic metabolism Anaerobic $t_{1/2}$	1.3 hours major degradates nitromethane and chloronitromethane	MRID# 43759301
Aquatic metabolism Aerobic $t_{1/2}$	N/A	Waived
K_{OC}	36.05 L kg^{-1}	EPISUITE
Laboratory Volatility	Non-tarped soil maximum volatility 342 µg/cm^2/hr; Tarped soil maximum volatility 205 µg/cm^2/hr	MRID# 43798601

Table 2.2. Environmental Fate Properties of Chloropicrin

Parameter	Value	Reference/Comments
Terrestrial Field Dissipation	≤1.4 days from 3- to 12-inch depth from a sandy loam and a sand from California, measured after tarp was removed	MRID# 43085101
Aquatic Field Dissipation	N/A	Waived
Accumulation in Fish, max. BCF	N/A	Waived

2.4.2 .Environmental Transport Assessment

Potential transport mechanisms include pesticide surface water runoff and secondary drift of volatilized or soil-bound residues leading to deposition onto nearby or more distant ecosystems. The magnitude of pesticide transport via secondary drift depends on the pesticide's ability to be mobilized into air and its eventual removal through wet and dry deposition of gases/particles and photochemical reactions in the atmosphere. A number of studies have documented atmospheric transport and redeposition of pesticides from the Central Valley to the Sierra Nevada mountains (Fellers et al., 2004, Sparling et al., 2001, LeNoir et al., 1999, and McConnell et al., 1998). Prevailing winds blow across the Central Valley eastward to the Sierra Nevada mountains, transporting airborne industrial and agricultural pollutants into Sierra Nevada ecosystems (Fellers et al., 2004, LeNoir et al., 1999, and McConnell et al., 1998). Therefore, physicochemical properties of the pesticide that describe its potential to enter the air from water or soil (e.g., Henry's Law constant and vapor pressure), pesticide use, modeled estimated concentrations in water and air, and available air monitoring data from the Central Valley and the Sierra Nevadas are considered in evaluating the potential for atmospheric transport of chloropicrin to habitat for the CRLF.

The dissipation of chloropicrin in aquatic and terrestrial environments appears to be predominantly dependent on volatilization and to a lesser extent on leaching and degradation. The high vapor pressure and the high Henry's Law Constant suggests that chloropicrin will volatilize from soil and water. Once volatilized, chloropicrin degrades rapidly into CO_2 and other metabolites in the atmosphere via direct photolysis. The importance of other competing processes such as leaching, biodegradation, and adsorption to the soil particles will certainly depend on chloropicrin emission rate from the fumigated fields. This is because emission rate determines the amount of chloropicrin left for other processes and its residence time in the soil system. The biodegradation half-lives of chloropicrin is 10 days with carbon dioxide being the terminal breakdown product (MRID 43613901). Also, literature data (Wilhelm et al., 1996, Gan et al., 2000) shows that major metabolic pathways occur through successive reductive dehalogenation of chloropicrin to nitromethane:

$$\mathbf{CCl_3NO_2 \rightarrow HCCl_2NO_2 \rightarrow H_2CClNO_2 \rightarrow H_3CNO_2 \rightarrow CO_2}$$

Degradation of chloropicrin in soil follows first-order kinetics. Wilhelm et al.(1996) estimated the half-life of 4.5 days for chloropicrin in sandy loam soil with a rate equivalent to

500 lbs/Acre following the Agency's Pesticide Assessment Guidelines. Gan et al. (2000) estimated that microbial degradation accounted for 68 to 92 percent of the overall degradation of applied chloropicrin.

Chloropicrin is highly soluble in water and is weakly retained by soil. The supplemental terrestrial field dissipation studies (MRID 43085101) were conducted in California, applying chloropicrin to bare fallow soils at rates of 665 lbs and 792 lbs a.i/acre through chisel injection followed by tarping for 48 hours. The calculated field dissipation half-lives were less than 33.4hours. Volatilization of chloropicrin from applied fields may have resulted in short half-lives in the field dissipation study. Concentrations of chloropicrin at the 24-, 36-, and 48-inch depths increased to a maximam of 593.0, 230.5, and 75.2 ppm, respectively; times of maximum concentration were 12, 24, and 48 hours, respectively, after removal of the tarp.

The high Henry's Law Constant (2.05 X 10^{-3} atm M^3/mole) and rapid photohydrolysis of chloropicrin suggest that volatilization and rapid degradation are the primary environmental routes of dissipation from surface water. The calculated half-life of 31.1 hours for in aqueous solution (pH 7) when irradiated with xenon light source forming carbon dioxide, chloride, nitrate and nitrite (MRID 42900201). In the absence of light, chloropicrin did not hydrolyzed in sterile aqueous buffered solution under acidic to alkaline pH (MRID 43022401).

The soil adsorption coefficient (K_{oc}) of chloropicrin cannot be estimated from the batch equilibrium study. Due to the rapid volatilization of chloropicrin, it is unlikely that an equilibrium of chloropicrin in the batch equilibrium will be reached. The K_{oc} of chloropicrin was estimated using the EPA's computer model PCKOCWIN v1.66 of EPISUITE (EPI). EPI's K_{oc} estimations are based on the Sabljic molecular connectivity method. The estimated K_{oc} of chloropicrin is 36.05 ml/g. Chloropicrin's high water solubility (1621 mg/L) and low K_{oc} of 36.05 ml/g suggest its high mobility in the environment. The high solubility and low soil absorption of chloropicrin can result in movement downward to groundwater with water infiltration under intense rainfall or continuous irrigation right after chloropicrin application. A supplemental leaching study (MRID 44191301) demonstrated that chloropicrin was very mobile in all four soils.

In a review of the environmental fate of chloropicrin, Kollman (1990), noted that chloropicrin was likely to have relatively short persistence in the atmosphere. Chloropicrin was found to be susceptible to direct photolytic degradation in air. Laboratory simulation of exposure to artificial sunlight found that it degraded with a half-life of 20 days (MRID 05007865, Moilanen et al. 1978). However, a later study using a light source that better simulated the spectral intensity of sunlight found chloropicrin to photolyze much more rapidly, with an estimated atmospheric half-life of 3.4 to 8 hours in direct sunlight (Carter et al., 1997), leading to an estimate of 1 day for its atmospheric lifetime. Since post application volatilization of chloropicrin tends to continue for several days, the secondary volatilized chloropicrin was evaluated to determine potential off-site transport of chloropicrin.

The highly toxic gas phosgene (once used as a chemical warfare agent) is a major photodegradation product of chloropicrin. Phosgene is resistant to both direct and indirect photochemical degradation processes in the atmosphere (Grosjean 1991; Helas and Wilson 1992), but it is extremely reactive with water, hydrolyzing rapidly to carbon dioxide and hydrochloric acid (Manoque and Pigford 1960). The dominant process removing phosgene from the atmosphere is its reaction with liquid water droplets (fog, clouds, and rain), with a tropospheric lifetime estimated at 10 hours to 1 day (Manoque and Pigford 1960). Despite its short atmospheric half life, phosgene has been commonly detected in air, especially in urban/industrial areas, with typical concentrations of 80 to 130 ng/m3 (WHO 1998). Phosgene is a widely used precursor in the chemical industry, with 3 x 10^6 metric tons produced and used annually (WHO 1998). Phosgene is also formed in the atmosphere by the photochemical oxidation of chloroethylenes, with generation rates estimated to be 350,000 metric tons annually (Singh 1976). Phosgene generation by conversion of 100% of chloropicrin used agriculturally in the U.S. would amount to about 6000 metric tons annually (based on U.S usage of 9000 metric tons/year (NASS 2005). Even with such unrealistic conversion assumptions, chloropicrin usage appears to be a minor source of atmospheric phosgene relative to other sources.

2.4.3 Mechanism of Action

Chloropicrin is a fumigant used in pre-plant soil fumigation. Chloropicrin's specific mode of action is not understood, but it is a strong irritant that is very toxic to all biological systems; affecting body surfaces and interfering with the respiratory system and the cellular transport of oxygen (U.S. Forest Service, 1995).

2.4.4 Use Characterization

Analysis of labeled use information is the critical first step in evaluating the federal action. The current labels for chloropicrin represent the FIFRA regulatory action; therefore, labeled use and application rates specified on the label form the basis of this assessment. The assessment of use information is critical to the development of the action area and selection of appropriate modeling scenarios and inputs.

Chloropicrin is a broad-spectrum fumigant used for the control of weeds, nematodes, insects, rodents, and certain fungi. Chloropicrin end-use products are packaged as 100% chloropicrin formulations as well as in combination formulations with methyl bromide and 1,3-Dichloropropene. In these combination end-use products, the percent active ingredient for chloropicrin can range from 20 to 55% when combined with methyl bromide and from 15 to 60% when combined with 1,3-Dichloropropene.

Nationally, chloropicrin is registered for pre-plant soil fumigation of fields to be planted with a wide variety of food, ornamental, and nursery crops. Typical use consists of making one application per year prior to planting a crop or multiple crops in the fumigated field. Individually, strawberries, tobacco, tomatoes, and peppers were the crops with the highest percentage of their overall acreage treated nationally from 1998 to 2000. The average annual percentages of crop treated for those crops, respectively, were 20, 15, 10, and 10 percent while the maximum percentages of crop treated, respectively, for those crops were 50, 20, 45, and 30 percent. Crops that use over a million pounds annually of chloropicrin in their production include tobacco (3.6 million pounds), tomatoes (1.7 million pounds), and strawberries (1.4 million pounds). Figure 2.1 shows the average annual pounds of active ingredient applied in various states for all surveyed crops, based on three years (2002 to 2004) of EPA data (USEPA 2005a).

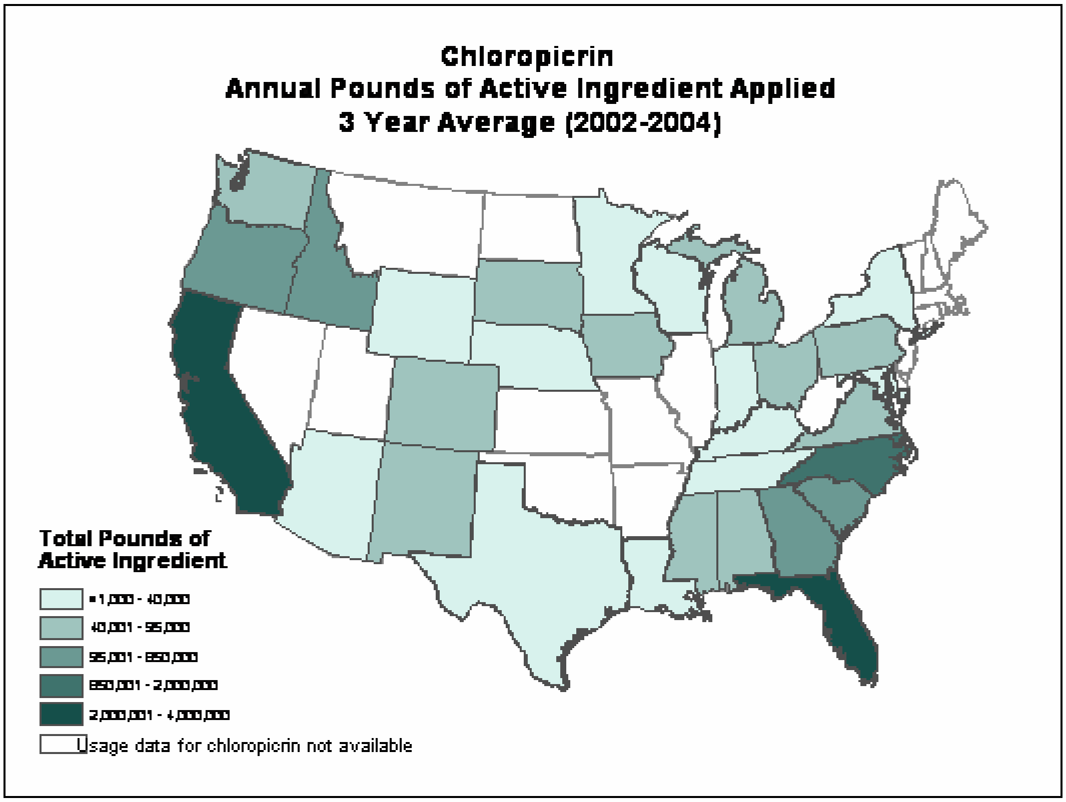


Figure 2.1. Average annual pounds of active ingredient of chloropicrin applied, by state for all surveyed crops, based on three years of EPA data (2002-2004).

Table 2.3 presents samples of national labels supporting chloropicrin application rates and methods for selected crops. The maximum application rate for soil injection is 1076 lbs a.i./A for "all crops" (with maximum "Suggested" rates of 400 – 500 lb ai/A for a variety of specific crops) on one label (EPA Reg. 8622-43). Chloropicrin can also be injected into trees and used to fumigate buildings ultimately being released into the air once fumigation is complete.

Table 2.3. Examples of National Labels Supporting Chloropicrin Application Rates for Agriculture and Non- agriculure uses

Crops	Label Reg#s	Label	Application rate frequency	Methods of Applications
Strawberry	8622-43	Metapicrin	500 lbs a.i./Acre 300 lbs a.i./Acre 1X Per Season	Shank Drip irrigation

Table 2.3. Examples of National Labels Supporting Chloropicrin Application Rates for Agriculture and Non- agriculure uses

Crops	Label Reg#s	Label	Application rate frequency	Methods of Applications
All crops Nursery	8622-43	Metapicrin	1076 lbs a.i./A 1X Per season	Shank injection
Potato	8622-43	Metapicrin	400 lbs a.i./Acre 300 lbs a.i./Acre 1X Per Season	Shank Injection Drip irrigation
Onion	8622-43	Metapicrin	400 lbs a.i./Acre 300 lbs a.i./Acre 1X Per Season	Shank Injection Drip irrigation
Tomato	8622-43	Metapicrin	500 lbs a.i./Acre 300 lbs a.i./Acre 1X Per Season	Shank Injection Drip irrigation
Cole Crop	8622-43	Metapicrin	500 lbs a.i./Acre 300 lbs a.i./Acre 1X Per Season	Shank Injection Drip irrigation
Melon	8622-43	Metapicrin	500 lbs a.i./Acre 300 lbs a.i./Acre 1X Per Season	Shank Injection Drip irrigation
Turf	5785-25	TERR-O-GAS 33	884.4 lbs a.i./Acre 1X Per Season	Shank Injection
All crops	8853-06	Pic Plus Fumigant	500 lbs a.i./Acre 1X Per Season	Shank Injection

The Chloropicrin Manufacturer's Task Force (CMTF) members have amended the four existing manufacturing labels to delete use of chloropicrin as an active ingredient in pesticide formulations for post-harvest uses, structural fumigations, forestry uses, and aquatic use patterns. The CMTF is supporting pre-plant soil fumigation use in agricultural fields and in commercial greenhouses, in empty grain and potato bins and in the remedial treatment of wood poles (e.g., telephone poles). In addition to this labeling change, CMTF is supporting the following maximum rates for pre-plant soil fumigation use in agricultural field. However, these changes in maximum rates have not been incorporated onto pesticide labeling and therefore, are not being used in this assessment as the maximum label rates.

- 350 lbs per treated acre for shank injection applications - tarped;
- 175 lbs per treated acre for shank injection applications - untarped;
- 300 lbs per treated acre for drip irrigation applications.
- 500 lbs for tree hole replant application (small area)

The uses considered in this risk assessment represent all currently registered uses according to a review of all current labels. No other uses are relevant to this assessment. Any reported uses not on current labels , such as may be seen in the CDPR PUR database, represent either historic uses that have been canceled, mis-reported uses, or mis-use. Historical uses, mis-reported uses, and misuse are not considered part of the federal action and, therefore, are not considered in this assessment. See Appendix F for a map of chloropicrin use in California.

2.4.4.1 Chloropicrin Management Practices

In general, two most frequent options of chloropicrin application methods include shank injection (soil injection) followed by tarping (Figure 2.2), cultipacking, or water sealing and drip irrigation (chemigation) under a pre-tarped soil surface (Figure 2.3); however tarping is not required. For drip irrigation, non-tarp chloropicrin application in soil requires the placement of drip tubing at a minimum depth of 5 inches from surface. Post application sealing methods like tarping, water sealing, and compacting soil surface are fumigant management practices followed immediately after fumigation to contain the applied chloropicrin and reduce its diffusion into the atmosphere. For the production of some crops, the entire field is treated and is termed "flat fume", "broadcast", or "broadacre" (Figure 2.2). For the production of other crops, fumigation occurs when planting beds are formed. A bed press forms a raised bed and the fumigant is injected into the bed as it is formed. The entire bed, or only a portion of the bed, is fumigated. This is termed "strip" treatments (Figure 2.3). The production of some ornamentals and strawberries use a combination of techniques. First, the entire field is fumigated and tarped. The tarps are then removed, raised beds are formed, and these beds are then tarped. There are a range of tarps used to reduce emission from the fumigated field (Table 2.4). Low density polyethylene (LDPE) and high density polyethylene (HDPE) are most commonly used for tarping. Recently, high barrier impermeable film (e.g., virtually impermeable film or VIP) was introduced to reduce emission from the fumigated field.

Figure 2.2. Shank injection and tarping during broadcast/flat fumigation

Figure 2.3. Typical drip irrigation system and beds for fumigation

Table 2.4. Summary of Recommended Fumigation Techniques*

Application Method	Application Equipment	Soil Incorporation Method	Field Treatment	Flat Fume vs. Raised Bed	Tarping / Sealing Method	
					Water Seal	Tarp
Shallow shank	spray blade, shank	Roller, rotary harrow, bed press	Entire field, strip (may be entire bed or only part of the raised bed)	Flat fume, raised bed	None, standard, intermittent	Untarped LDPE HDPE High barrier
Deep shank	Shank	Roller, rotary harrow, bed press	Entire field, strip (entire bed)	Flat fume, raised bed	N/A	Untarped LDPE HDPE High barrier
Chemigation	Drip line	None (drip tape(s) under tarp	Entire field, strip (entire bed)	Flat fume, raised bed	N/A	Untarped LDPE HDPE High barrier

*Combinations of formulation, application methods and equipment, soil incorporation methods, field treatments, and tarping / sealing methods vary by fumigant, crop, and geographic region. Note that not all potential combinations are used (e.g., water seals are not used with tarps).

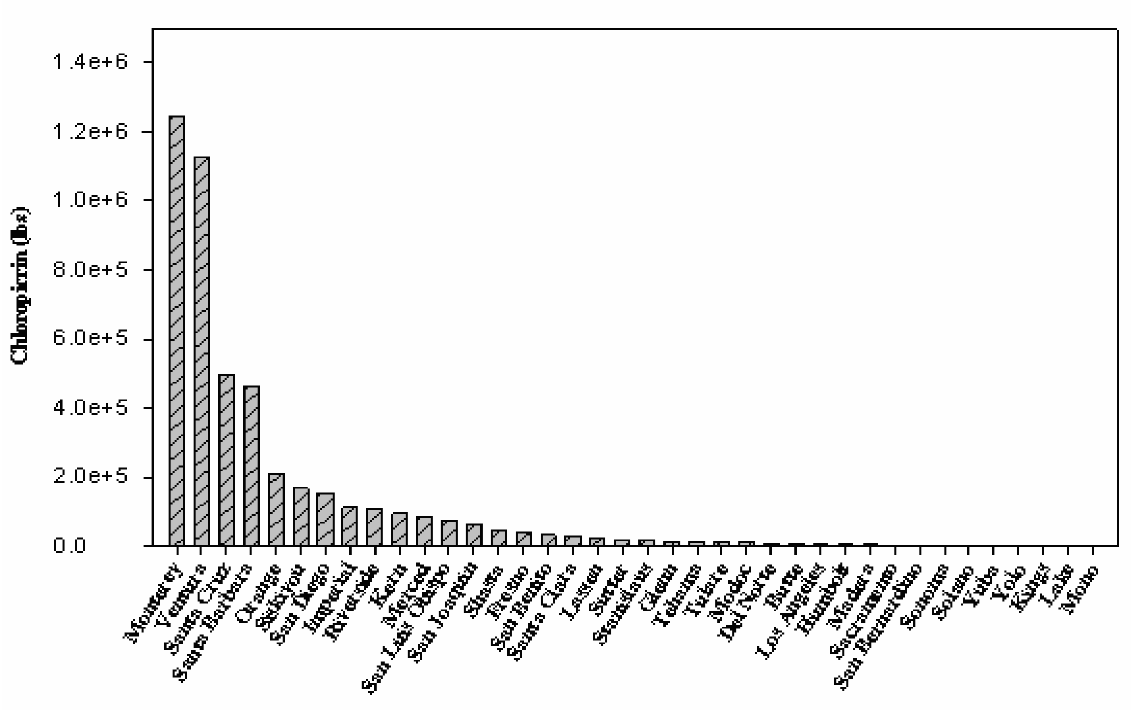


Figure 2..4. Chloropicrin Use in California (2002 - 2005) by County.

2.4.4.2 Chloropicrin Use Characterization in California

Data on the use of chloropicrin ranges from robust to very sparse. The primary source of publicly available data is the Department of Agriculture's National Agricultural Statistics Service (USDA-NASS). The Agency's Biological and Economic Analysis Division (BEAD) provides an analysis of both national- and county-level usage information using state-level usage data obtained from USDA-NASS, Doane (www.doane.com; the full dataset is not provided due to its proprietary nature), and the California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database. California State law requires that every pesticide application be reported to the state and made available to the public. CDPR PUR is considered a more comprehensive source of usage data than USDA-NASS or EPA proprietary databases, and thus the usage data reported for chloropicrin by county in this California-specific assessment were generated using CDPR PUR data. Usage data are averaged together over the years 2002 to 2005 to calculate average annual usage statistics by county and crop for chloropicrin, including pounds of active ingredient applied. The summary of chloropicrin usage for all use sites, including both agricultural and non-agricultural, is provided in Figure 2.4. Highest usage (> 200,000 lbs of chloropicrin) was reported in Monterey, Ventura, Santa Cruz, and Orange counties. Usages data from California also suggest that strawberry appear to have the most pounds applied overall with an average of an estimated 3,134,572 pounds during 2002 to 2004 (Figure 2.5).

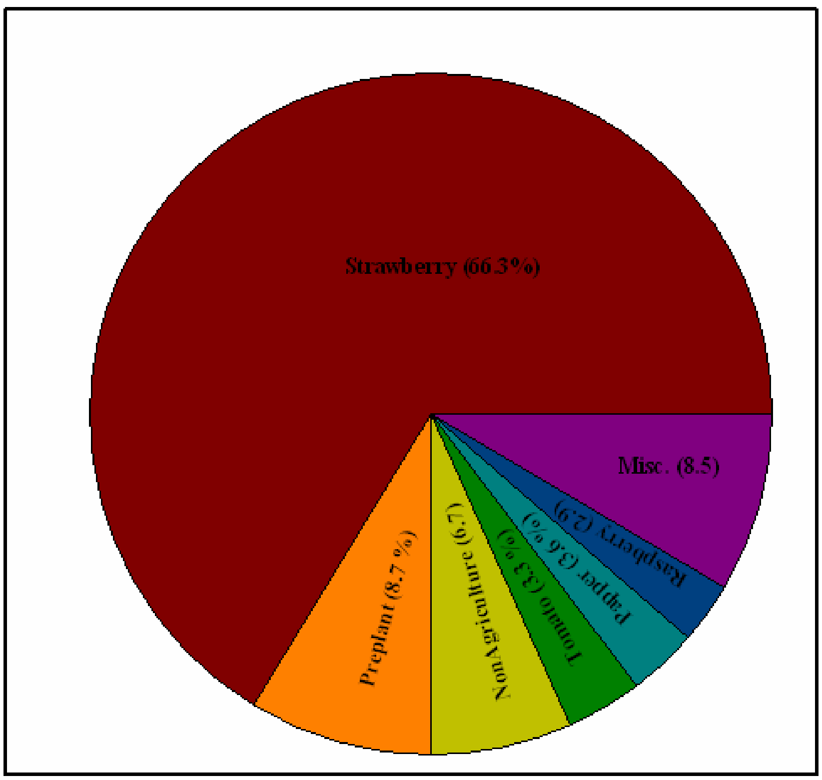


Figure 2.5. Distribution of major usage of chloropicrin in California during 2002-2005

2.5 Assessed Species

The CRLF was federally listed as a threatened species by USFWS effective June 24, 1996 (USFWS 1996). It is one of two subspecies of the red-legged frog and is the largest native frog in the western United States (USFWS 2002). A brief summary of information regarding CRLF distribution, reproduction, diet, and habitat requirements is provided in Sections 2.5.1 through 2.5.4, respectively. Further information on the status, distribution, and life history of and specific threats to the CRLF is provided in **Attachment 1**.

Final critical habitat for the CRLF was designated by USFWS on April 13, 2006 (USFWS 2006; 71 FR 19244-19346). Further information on designated critical habitat for the CRLF is provided in Section 2.6.

2.5.1 Distribution

The CRLF is endemic to California and Baja California (Mexico) and historically inhabited 46 counties in California including the Central Valley and both coastal and interior mountain ranges (USFWS 1996). Its range has been reduced by about 70%, and the species currently resides in 22 counties in California (USFWS 1996). The species has an elevational range of near sea level to 1,500 meters (5,200 feet) (Jennings and Hayes 1994); however, nearly all of the known CRLF populations have been documented below 1,050 meters (3,500 feet) (USFWS 2002).

Populations currently exist along the northern California coast, northern Transverse Ranges (USFWS 2002), foothills of the Sierra Nevada (5-6 populations), and in southern California south of Santa Barbara (two populations) (Fellers 2005a). Relatively larger numbers of CRLFs are located between Marin and Santa Barbara Counties (Jennings and Hayes 1994). A total of 243 streams or drainages are believed to be currently occupied by the species, with the greatest numbers in Monterey, San Luis Obispo, and Santa Barbara counties (USFWS 1996). Occupied drainages or watersheds include all bodies of water that support CRLFs (i.e., streams, creeks, tributaries, associated natural and artificial ponds, and adjacent drainages), and habitats through which CRLFs can move (i.e., riparian vegetation, uplands) (USFWS 2002).

The distribution of CRLFs within California is addressed in this assessment using four categories of location including recovery units, core areas, designated critical habitat, and known occurrences of the CRLF reported in the California Natural Diversity Database (CNDDB) that are not included within core areas and/or designated critical habitat (see Figure 2.a). Recovery units, core areas, and other known occurrences of the CRLF from the CNDDB are described in further detail in this section, and designated critical habitat is addressed in Section 2.6. Recovery units are large areas defined at the watershed level that have similar conservation needs and management strategies. The recovery unit is primarily an administrative designation, and land area within the recovery unit boundary is not exclusively CRLF habitat. Core areas are smaller areas within the recovery units that comprise portions of the species' historic and current range and have been determined by

USFWS to be important in the preservation of the species. Designated critical habitat is generally contained within the core areas, although a number of critical habitat units are outside the boundaries of core areas, but within the boundaries of the recovery units. Additional information on CRLF occurrences from the CNDDB is used to cover the current range of the species not included in core areas and/or designated critical habitat, but within the recovery units.

Recovery Units

Eight recovery units have been established by USFWS for the CRLF. These areas are considered essential to the recovery of the species, and the status of the CRLF "may be considered within the smaller scale of the recovery units, as opposed to the statewide range" (USFWS 2002). Recovery units reflect areas with similar conservation needs and population statuses, and therefore, similar recovery goals. The eight units described for the CRLF are delineated by watershed boundaries defined by US Geological Survey hydrologic units and are limited to the elevational maximum for the species of 1,500 m above sea level. The eight recovery units for the CRLF are listed in Table 2.b and shown in Figure 2.6.

Core Areas

USFWS has designated 35 core areas across the eight recovery units to focus their recovery efforts for the CRLF (see Figure 2.a). Table 2.b summarizes the geographical relationship among recovery units, core areas, and designated critical habitat. The core areas, which are distributed throughout portions of the historic and current range of the species, represent areas that allow for long-term viability of existing populations and reestablishment of populations within historic range. These areas were selected because they: 1) contain existing viable populations; or 2) they contribute to the connectivity of other habitat areas (USFWS 2002). Core area protection and enhancement are vital for maintenance and expansion of the CRLF's distribution and population throughout its range.

For purposes of this assessment, designated critical habitat, currently occupied (post-1985) core areas, and additional known occurrences of the CRLF from the CNDDB are considered. Each type of locational information is evaluated within the broader context of recovery units. For example, if no labeled uses of chloropicrin occur (or if labeled uses occur at predicted exposures less than the Agency's LOCs) within an entire recovery unit, a "no effect" determination would be made for all designated critical habitat, currently occupied core areas, and other known CNDDB occurrences within that recovery unit. Historically occupied sections of the core areas are not evaluated as part of this assessment because the USFWS Recovery Plan (USFWS 2002) indicates that CRLFs are extirpated from these areas. A summary of currently and historically occupied core areas is provided in Table 2.b (currently occupied core areas are bolded). While core areas are considered essential for recovery of the CRLF, core areas are not federally-designated critical habitat, although designated critical habitat is generally contained within these core recovery areas. It should be noted, however, that several critical habitat units are located outside of the core areas, but within the recovery units. The focus of this assessment is currently occupied core areas, designated critical habitat, and other known CNDDB CRLF occurrences within the recovery units. Federally-designated critical habitat for the CRLF is further explained in Section 2.6.

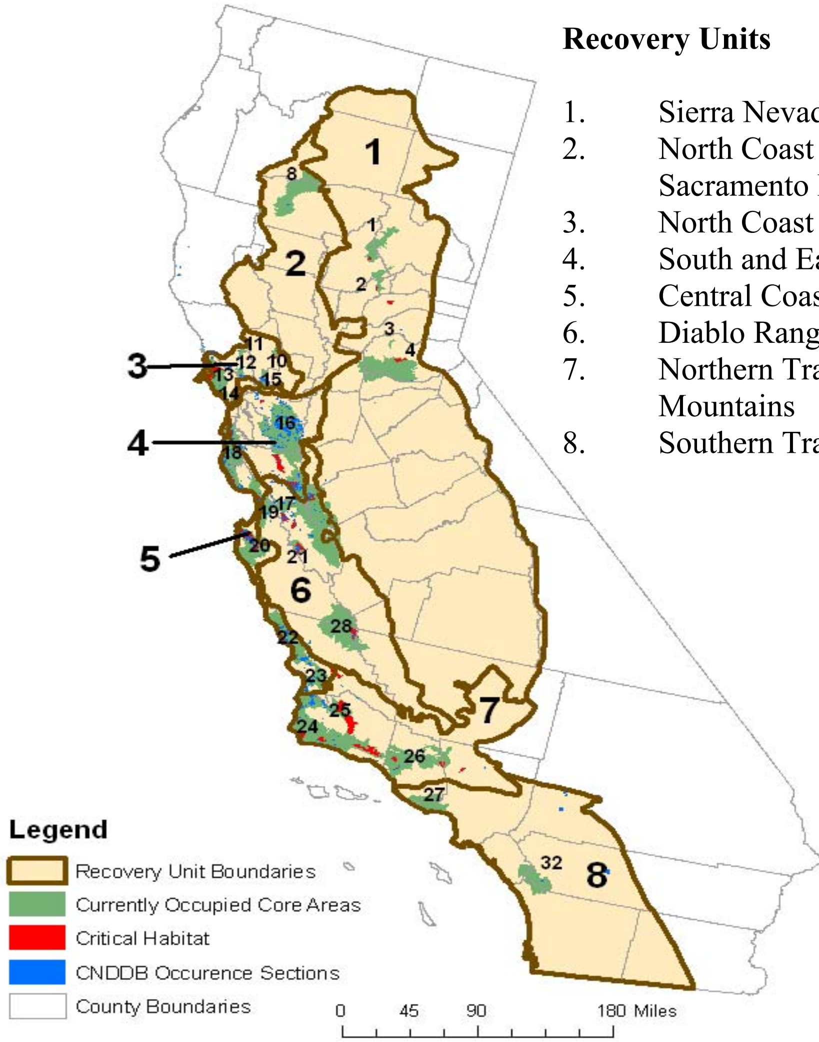
Table 2.5. California Red-legged Frog Recovery Units with Overlapping Core Areas and Designated Critical Habitat

Recovery Unit [1] (Figure 2.a)	**Core Areas [2,7] (Figure 2.a)**	**Critical Habitat Units [3]**	**Currently Occupied (post-1985) [4]**	**Historically Occupied [4]**
Sierra Nevada Foothills and Central Valley (1) (eastern boundary is the 1,500m elevation line)	**Cottonwood Creek (partial) (8)**	--	✓	
	Feather River (1)	BUT-1A-B	✓	
	Yuba River-S. Fork Feather River (2)	YUB-1		
	--	NEV-1	✓[6]	
	Traverse Creek/Middle Fork American River/Rubicon (3)	--	✓	
	Consumnes River (4)	ELD-1	✓	
	S. Fork Calaveras River (5)	--		✓
	Tuolumne River (6)	--		✓
	Piney Creek (7)	--		✓
	East San Francisco Bay (partial)(16)	--	✓	
North Coast Range Foothills and Western Sacramento River Valley (2)	**Cottonwood Creek (8)**	--	✓	
	Putah Creek-Cache Creek (9)	--		✓
	Jameson Canyon – Lower Napa Valley (partial) (15)	--	✓	
	Belvedere Lagoon (partial) (14)	--	✓	
	Pt. Reyes Peninsula (partial) (13)	--	✓	
North Coast and North San Francisco Bay (3)	Putah Creek-Cache Creek (partial) (9)	--		✓
	Lake Berryessa Tributaries (10)	NAP-1	✓	
	Upper Sonoma Creek (11)	--	✓	
	Petaluma Creek-Sonoma Creek (12)	--	✓	
	Pt. Reyes Peninsula (13)	MRN-1, MRN-2	✓	
	Belvedere Lagoon (14)	--	✓	
	Jameson Canyon-Lower Napa River (15)	SOL-1	✓	
South and East San Francisco Bay (4)	--	CCS-1A	✓[6]	
	East San Francisco Bay (partial) (16)	ALA-1A, ALA-1B, STC-1B	✓	
	--	STC-1A	✓[6]	
	South San Francisco Bay (partial) (18)	SNM-1A	✓	
Central Coast (5)	**South San Francisco Bay (partial) (18)**	SNM-1A, SNM-2C, SCZ-1	✓	
	Watsonville Slough- Elkhorn Slough (partial) (19)	SCZ-2 [5]	✓	

Table 2.5. California Red-legged Frog Recovery Units with Overlapping Core Areas and Designated Critical Habitat

Recovery Unit [1] (Figure 2.a)	Core Areas [2,7] (Figure 2.a)	Critical Habitat Units [3]	Currently Occupied (post-1985) [4]	Historically Occupied [4]
	Carmel River-Santa Lucia (20)	MNT-2	✓	
	Estero Bay (22)	--	✓	
	Arroyo Grande Creek (23)	SLO-8	✓	
	Santa Maria River-Santa Ynez River (24)	--	✓	
Diablo Range and Salinas Valley (6)	**East San Francisco Bay (partial) (16)**	MER-1A-B	✓	
	--	SNB-1, SNB-2	✓[6]	
	Santa Clara Valley (17)	--	✓	
	Watsonville Slough- Elkhorn Slough (partial)(19)	MNT-1	✓	
	Carmel River-Santa Lucia (partial)(20)	--	✓	
	Gablan Range (21)	SNB-3	✓	
	Estrella River (28)	SLO-1-A-B	✓	
Northern Transverse Ranges and Tehachapi Mountains (7)	--	SLO-8	✓[6]	
	Santa Maria River-Santa Ynez River (24)	STB-4, STB-5, STB-7	✓	
	Sisquoc River (25)	STB-1, STB-3	✓	
	Ventura River-Santa Clara River (26)	VEN-1, VEN-2, VEN-3	✓	
	--	LOS-1	✓[6]	
Southern Transverse and Peninsular Ranges (8)	**Santa Monica Bay-Ventura Coastal Streams (27)**	--	✓	
	San Gabriel Mountain (29)	--		✓
	Forks of the Mojave (30)	--		✓
	Santa Ana Mountain (31)	--		✓
	Santa Rosa Plateau (32)	--	✓	
	San Luis Rey (33)	--		✓
	Sweetwater (34)	--		✓
	Laguna Mountain (35)	--		✓

[1] Recovery units designated by the USFWS (USFWS 2002, pg 49)
[2] Core areas designated by the USFWS (USFWS 2002, pg 51)
[3] Critical habitat units designated by the USFWS on April 13, 2006 (USFWS 2006, 71 FR 19244-19346)
[4] Currently occupied (post-1985) core areas and core areas historically occupied only (i.e., not currently occupied) designated by the USFWS (USFWS 2002, pg 54)
[5] Critical habitat unit where identified threats specifically included pesticides or agricultural runoff (USFWS)
[6] Critical habitat units that are outside of core areas, but within recovery units
[7] Currently occupied core areas that are included in this effects determination are bolded.



Recovery Units

1. Sierra Nevada Foothills and Central Valley
2. North Coast Range Foothills and Western Sacramento River Valley
3. North Coast and North San Francisco Bay
4. South and East San Francisco Bay
5. Central Coast
6. Diablo Range and Salinas Valley
7. Northern Transverse Ranges and Tehachapi Mountains
8. Southern Transverse and Peninsular

Core Areas

1. Feather River
1. Yuba River- S. Fork Feather River
2. Traverse Creek/ Middle Fork/ American R. Rubicon
3. Cosumnes River
4. South Fork Calaveras River*
5. Tuolumne River*
6. Piney Creek*
7. Cottonwood Creek
8. Putah Creek – Cache Creek*
9. Lake Berryessa Tributaries
10. Upper Sonoma Creek
11. Petaluma Creek – Sonoma Creek
12. Pt. Reyes Peninsula
13. Belvedere Lagoon
14. Jameson Canyon – Lower Napa River
15. East San Francisco Bay
16. Santa Clara Valley
17. South San Francisco Bay
18. Watsonville Slough-Elkhorn Slough
19. Carmel River – Santa Lucia
20. Gablan Range
21. Estero Bay
22. Arroyo Grange River
23. Santa Maria River – Santa Ynez River
24. Sisquoc River
25. Ventura River – Santa Clara River
26. Santa Monica Bay – Venura Coastal Streams
27. Estrella River
28. San Gabriel Mountain*
29. Forks of the Mojave*
30. Santa Ana Mountain*
31. Santa Rosa Plateau
32. San Luis Ray*
33. Sweetwater*
34. Laguna Mountain*

* Core areas that were historically occupied by the California red-legged frog are not included in the map

Figure 2.6. Recovery Unit, Core Area, Critical Habitat, and Occurrence Designations for CRLF

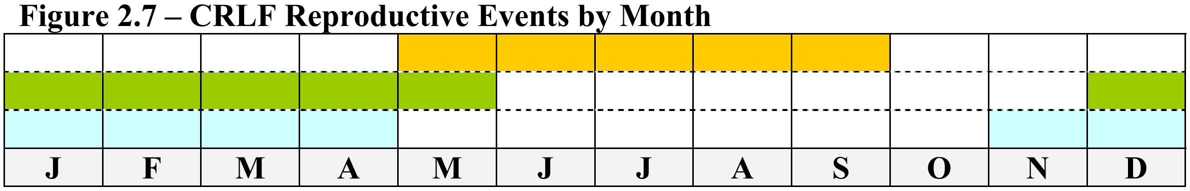
Other Known Occurrences from the CNDBB

The CNDDB provides location and natural history information on species found in California. The CNDDB serves as a repository for historical and current species location sightings. Information regarding known occurrences of CRLFs outside of the currently occupied core areas and designated critical habitat is considered in defining the current range of the CRLF. See: http://www.dfg.ca.gov/bdb/html/cnddb_info.html for additional information on the CNDDB.

2.5.2 Reproduction

CRLFs breed primarily in ponds; however, they may also breed in quiescent streams, marshes, and lagoons (Fellers 2005a). According to the Recovery Plan (USFWS 2002), CRLFs breed from November through late April. Peaks in spawning activity vary geographically; Fellers (2005b) reports peak spawning as early as January in parts of coastal central California. Eggs are fertilized as they are being laid. Egg masses are typically attached to emergent vegetation, such as bulrushes (*Scirpus* spp.) and cattails (*Typha* spp.) or roots and twigs, and float on or near the surface of the water (Hayes and Miyamoto 1984). Egg masses contain approximately 2000 to 6000 eggs ranging in size between 2 and 2.8 mm (Jennings and Hayes 1994). Embryos hatch 10 to 14 days after fertilization (Fellers 2005a) depending on water temperature. Egg predation is reported to be infrequent and most mortality is associated with the larval stage (particularly through predation by fish); however, predation on eggs by newts has also been reported (Rathburn 1998). Tadpoles require 11 to 28 weeks to metamorphose into juveniles (terrestrial-phase), typically between May and September (Jennings and Hayes 1994, USFWS 2002); tadpoles have been observed to over-winter (delay metamorphosis until the following year) (Fellers 2005b, USFWS 2002). Males reach sexual maturity at 2 years, and females reach sexual maturity at 3 years of age; adults have been reported to live 8 to 10 years (USFWS 2002). Figure 2.7 depicts CRLF annual reproductive timing.

Figure 2.7 – CRLF Reproductive Events by Month



Light Blue = **Breeding/Egg Masses**
Green = **Tadpoles (except those that over-winter)**
Orange = **Young Juveniles**
Adults and juveniles can be present all year

2.5.3 Diet

Although the diet of CRLF aquatic-phase larvae (tadpoles) has not been studied specifically, it is assumed that their diet is similar to that of other frog species, with the aquatic phase feeding exclusively in water and consuming diatoms, algae, and detritus (USFWS 2002). Tadpoles filter and entrap suspended algae (Seale and Beckvar, 1980) via mouthparts designed for effective grazing of periphyton (Wassersug, 1984, Kupferberg *et al.*; 1994; Kupferberg, 1997; Altig and McDiarmid, 1999).

Juvenile and adult CRLFs forage in aquatic and terrestrial habitats, and their diet differs greatly from that of larvae. The main food source for juvenile aquatic- and terrestrial-phase CRLFs is thought to be aquatic and terrestrial invertebrates found along the shoreline and on the water surface. Hayes and Tennant (1985) report, based on a study examining the gut content of 35 juvenile and adult CRLFs, that the species feeds on as many as 42 different invertebrate taxa, including Arachnida, Amphipoda, Isopoda, Insecta, and Mollusca. The most commonly observed prey species were larval alderflies (*Sialis* cf. *californica*), pillbugs (*Armadilliadrium vulgare*), and water striders (*Gerris* sp). The preferred prey species, however, was the sowbug (Hayes and Tennant, 1985). This study suggests that CRLFs forage primarily above water, although the authors note other data reporting that adults also feed under water, are cannibalistic, and consume fish. For larger CRLFs, over 50% of the prey mass may consists of vertebrates such as mice, frogs, and fish, although aquatic and terrestrial invertebrates were the most numerous food items (Hayes and Tennant 1985). For adults, feeding activity takes place primarily at night; for juveniles feeding occurs during the day and at night (Hayes and Tennant 1985).

2.5.4 Habitat

CRLFs require aquatic habitat for breeding, but also use other habitat types including riparian and upland areas throughout their life cycle. CRLF use of their environment varies; they may complete their entire life cycle in a particular habitat or they may utilize multiple habitat types. Overall, populations are most likely to exist where multiple breeding areas are embedded within varying habitats used for dispersal (USFWS 2002). Generally, CRLFs utilize habitat with perennial or near-perennial water (Jennings et al. 1997). Dense vegetation close to water, shading, and water of moderate depth are habitat features that appear especially important for CRLF (Hayes and Jennings 1988). Breeding sites include streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds (land depressions between fault zones that have filled with water), dune ponds, and lagoons. Breeding adults have been found near deep (0.7 m) still or slow moving water surrounded by dense vegetation (USFWS 2002); however, the largest number of tadpoles have been found in shallower pools (0.26 – 0.5 m) (Reis, 1999). Data indicate that CRLFs do not frequently inhabit vernal pools, as conditions in these habitats generally are not suitable (Hayes and Jennings 1988).

CRLFs also frequently breed in artificial impoundments such as stock ponds, although additional research is needed to identify habitat requirements within artificial ponds (USFWS 2002). Adult CRLFs use dense, shrubby, or emergent vegetation closely associated with deep-water pools bordered with cattails and dense stands of overhanging vegetation (http://www.fws.gov/endangered/features/rl_frog/rlfrog.html#where).

In general, dispersal and habitat use depends on climatic conditions, habitat suitability, and life stage. Adults rely on riparian vegetation for resting, feeding, and dispersal. The foraging quality of the riparian habitat depends on moisture, composition of the plant community, and presence of pools and backwater aquatic areas for breeding. CRLFs can be found living within streams at distances up to 3 km (2 miles) from their breeding site and have been found up to 30 m (100 feet) from water in dense riparian vegetation for up to 77 days (USFWS 2002).

During dry periods, the CRLF is rarely found far from water, although it will sometimes disperse from its breeding habitat to forage and seek other suitable habitat under downed trees or logs, industrial debris, and agricultural features (UWFWS 2002). According to Jennings and Hayes (1994), CRLFs also use small mammal burrows and moist leaf litter as habitat. In addition, CRLFs may also use large cracks in the bottom of dried ponds as refugia; these cracks may provide moisture for individuals avoiding predation and solar exposure (Alvarez 2000).

2.6 Designated Critical Habitat

In a final rule published on April 13, 2006, 34 separate units of critical habitat were designated for the CRLF by USFWS (USFWS 2006; FR 51 19244-19346). A summary of the 34 critical habitat units relative to USFWS-designated recovery units and core areas (previously discussed in Section 2.5.1) is provided in Table 2.5.

'Critical habitat' is defined in the ESA as the geographic area occupied by the species at the time of the listing where the physical and biological features necessary for the conservation of the species exist, and there is a need for special management to protect the listed species. It may also include areas outside the occupied area at the time of listing if such areas are 'essential to the conservation of the species.' All designated critical habitat for the CRLF was occupied at the time of listing. Critical habitat receives protection under Section 7 of the ESA through prohibition against destruction or adverse modification with regard to actions carried out, funded, or authorized by a federal Agency. Section 7 requires consultation on federal actions that are likely to result in the destruction or adverse modification of critical habitat.

To be included in a critical habitat designation, the habitat must be 'essential to the conservation of the species.' Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas that provide essential life cycle needs of the species or areas that contain certain primary constituent elements (PCEs) (as defined in 50 CFR 414.12(b)). PCEs include, but are not limited to, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. The designated critical habitat areas for the CRLF are considered to have the following PCEs that justify critical habitat designation:

- Breeding aquatic habitat;
- Non-breeding aquatic habitat;
- Upland habitat; and
- Dispersal habitat.

Please note that a more complete description of these habitat types is provided in **Attachment 1**.
Occupied habitat may be included in the critical habitat only if essential features within the habitat may require special management or protection. Therefore, USFWS does not include areas where existing management is sufficient to conserve the species. Critical habitat is designated outside the geographic area presently occupied by the species only when a designation limited to its present range would be inadequate to ensure the conservation of the species. For the CRLF, all designated critical habitat units contain all four of the PCEs, and were occupied by the CRLF at the time of FR listing notice in April 2006. The FR notice designating critical habitat for the CRLF includes a special rule exempting routine ranching activities associated with livestock ranching from incidental take prohibitions. The purpose of this exemption is to promote the conservation of rangelands, which could be beneficial to the CRLF, and to reduce the rate of conversion to other land uses that are incompatible with CRLF conservation. Please see **Attachment 1** for a full explanation on this special rule.

USFWS has established adverse modification standards for designated critical habitat (USFWS 2006). Activities that may destroy or adversely modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the species. Evaluation of actions related to use of chloropicrin that may alter the PCEs of the CRLF's critical habitat form the basis of the critical habitat impact analysis. According to USFWS (2006), activities that may affect critical habitat and therefore result in adverse effects to the CRLF include, but are not limited to the following:

(1) Significant alteration of water chemistry or temperature to levels beyond the tolerances of the CRLF that result in direct or cumulative adverse effects to individuals and their life-cycles.
(2) Significant increase in sediment deposition within the stream channel or pond or disturbance of upland foraging and dispersal habitat that could result in elimination or reduction of habitat necessary for the growth and reproduction of the CRLF by increasing the sediment deposition to levels that would adversely affect their ability to complete their life cycles.
(3) Significant alteration of channel/pond morphology or geometry that may lead to changes to the hydrologic functioning of the stream or pond and alter the timing, duration, water flows, and levels that would degrade or eliminate the CRLF and/or its habitat. Such an effect could also lead to increased sedimentation and degradation in water quality to levels that are beyond the CRLF's tolerances.
(4) Elimination of upland foraging and/or aestivating habitat or dispersal habitat.
(5) Introduction, spread, or augmentation of non-native aquatic species in stream

segments or ponds used by the CRLF.

(6) Alteration or elimination of the CRLF's food sources or prey base (also evaluated as indirect effects to the CRLF).

As previously noted in Section 2.1, the Agency believes that the analysis of direct and indirect effects to listed species provides the basis for an analysis of potential effects on the designated critical habitat. Because chloropicrin is expected to directly impact living organisms within the action area, critical habitat analysis for chloropicrin is limited in a practical sense to those PCEs of critical habitat that are biological or that can be reasonably linked to biologically mediated processes.

2.7 Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). It is recognized that the overall action area for the national registration of chloropicrin is likely to encompass considerable portions of the United States based on the large array of agricultural and non-agricultural uses. However, the scope of this assessment limits consideration of the overall action area to those portions that may be applicable to the protection of the CRLF and its designated critical habitat within the state of California. Deriving the geographical extent of this portion of the action area is the product of consideration of the types of effects that chloropicrin may be expected to have on the environment, the exposure levels to chloropicrin that are associated with those effects, and the best available information concerning the use of chloropicrin and its fate and transport within the state of California.

The definition of action area requires a stepwise approach that begins with an understanding of the federal action. The federal action is defined by the currently labeled uses for chloropicrin. An analysis of labeled uses and review of available product labels was completed. This analysis indicates that, for chloropicrin, the following uses are considered as part of the federal action evaluated in this assessment:

- All agricultural crops
- Commercial storages/warehouse premises
- Commercial facilities (non-food/nonfeed)
- Compost/compost piles
- Food processing plant premises
- Forest trees
- Golf course turf
- Mulch
- Non-ag rights of way, fencerows, hedgerows
- Non-ag uncultivated areas/soils
- Ornamental and/or shade trees
- Ornamental herbaceous plants

- Ornamental lawns and turf
- Ornamental non-flowering plants
- Ornamental woody shrubs and vines
- Potting soil/topsoil
- Recreational area lawns
- Recreational areas

The risk assessment will focus quantitatively on the agricultural use of chloropicrin, which has the highest application rates and is expected to present the greatest risk to non-target organisms. The analysis indicates that the following uses are not being assessed (or not assessed quantitatively) given that the use is not expected to result in exposure to the CRLF and/or scenarios for assessment of non-target wildlife are not available: airtight chambers, automobiles, eating establishments, empty containers, greenhouses, household/domestic dwellings indoor premises/content, mushroom houses, poultry, ships and boats, and soil-preplant indoor (indoor uses); wood protection treatment to forest products (the chemical is injected into pole in bored holes, which are plugged to prevent leakage of the chemical); and tobacco (not grown in California).

After determination of which uses will be assessed, an evaluation of the potential "footprint" of the use pattern is determined. This "footprint" represents the initial area of concern and is typically based on available land cover data. The initial area of concern is defined as all land cover types that represent the labeled uses described above. A map representing all the land cover types that make up the initial area of concern is presented in **Figure 2.8**. While forest trees (tree and stump injection) is a current use of potential concern, it is not on the Initial Area of Concern map since it is not assessed quantitatively. See Appendix F for further details on map development.

Once the initial area of concern is defined, the next step is to compare the extent of that area with the results of the screening level risk assessment. The screening level risk assessment will define which taxa, if any, are predicted to be exposed at concentrations above the Agency's Levels of Concern (LOC). The screening level assessment includes an evaluation of the environmental fate properties of chloropicrin to determine which routes of transport are likely to have an impact on the CRLF. LOC exceedances are used to describe how far effects may be seen from the initial area of concern. Factors considered include: spray drift, downstream run-off, atmospheric transport, etc. This information is incorporated into GIS and a map of the action area is created.

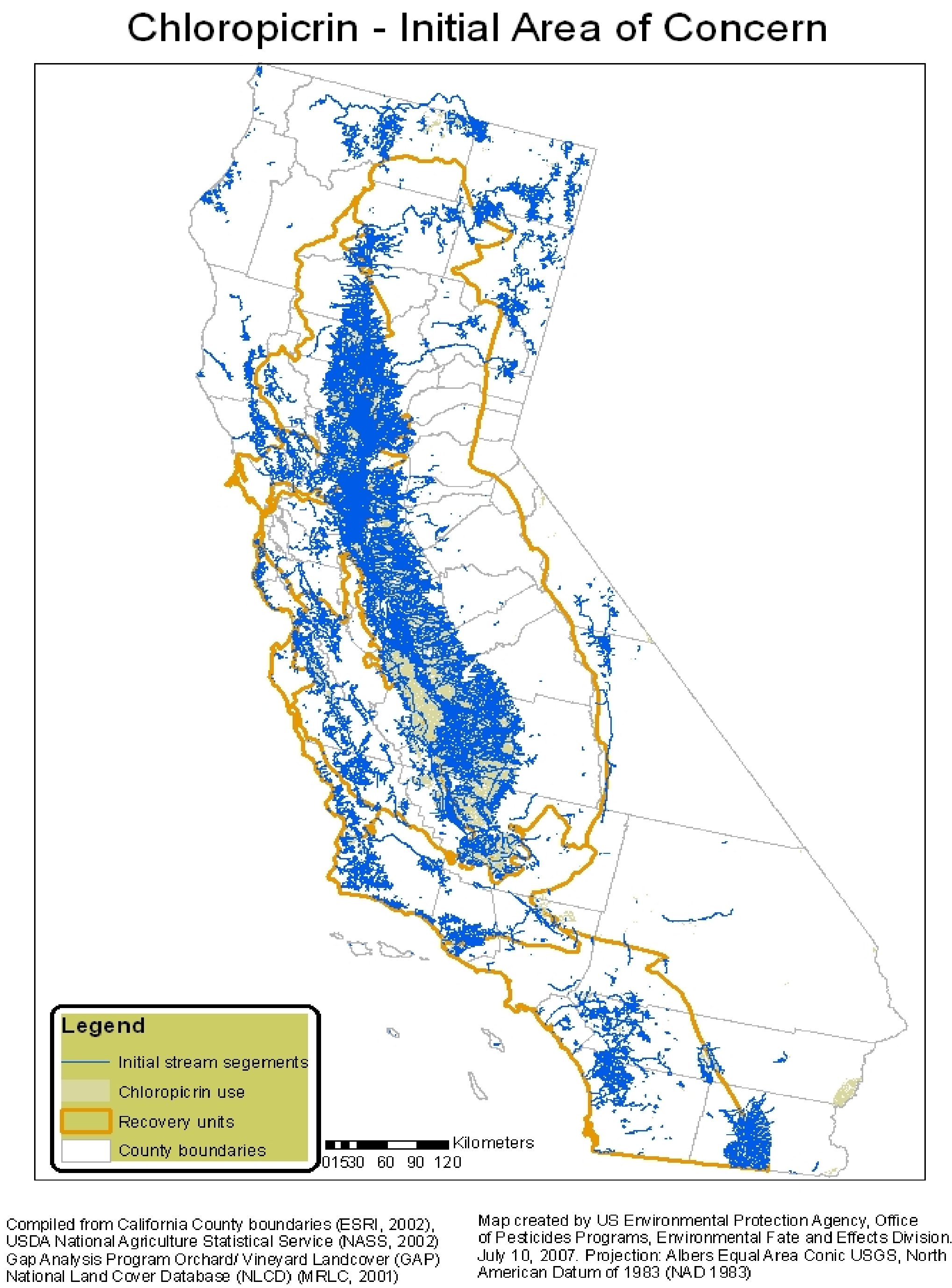


Figure 8. Initial Area of Concern for Chloropicrin

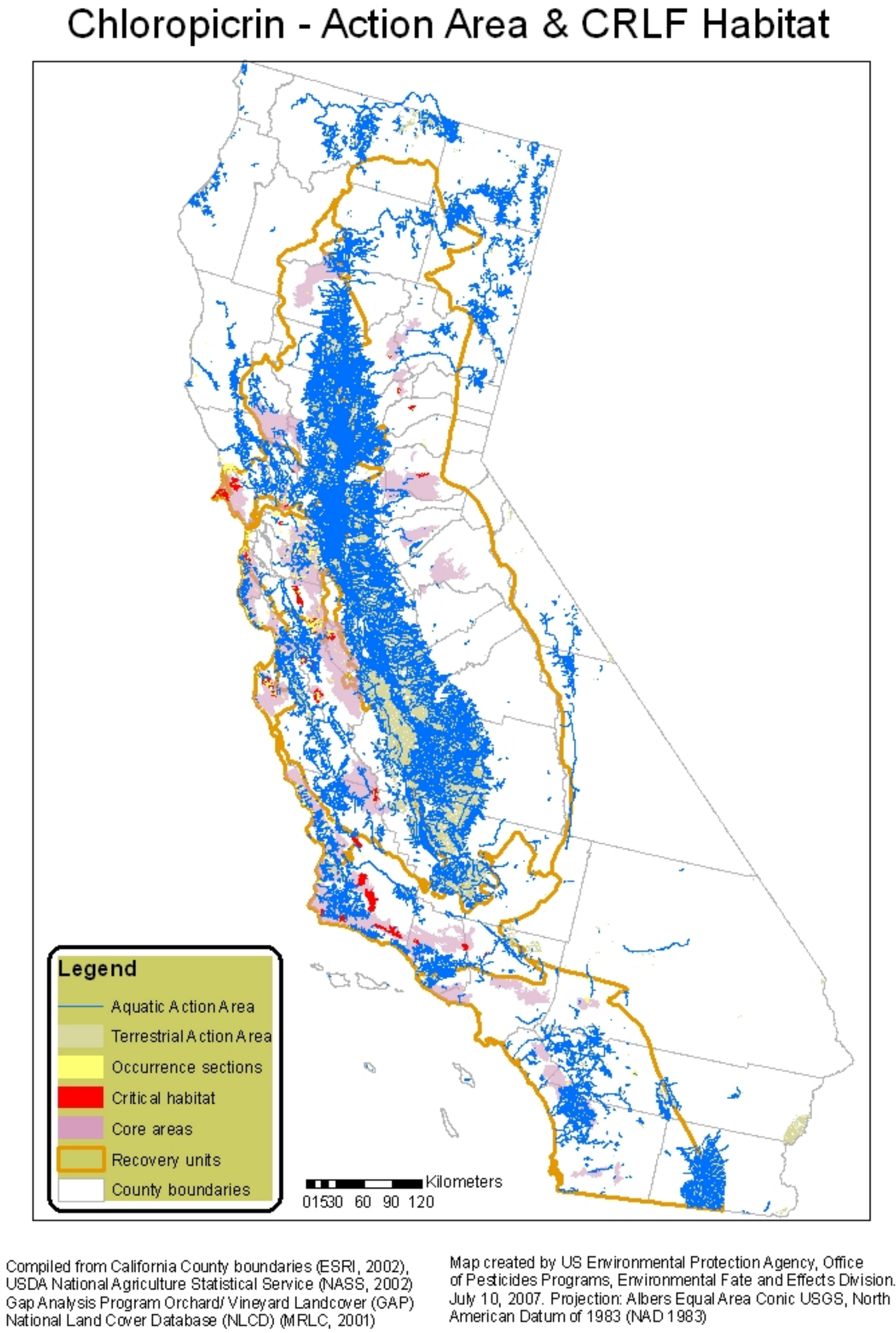


Figure 9. Action Area and CRLF Habitat.

For chloropicrin, the initial area of concern map is expanded to show the minimum downstream extent of potential aquatic LOC exceedances. This is based on available risk quotients and a simple dilution model (see Appendix F for details). Terrestrial plants, invertebrates, and vertebrates (including the CRLF) may also potentially be adversely affected by chloropicrin off-gassing, and thus the action area also extends some uncertain amount beyond the field edge based on terrestrial exposure. Data are not adequate for LOC calculations for plants and invertebrates. Official LOCs do not exist for inhalation exposure, but the **P**robabilistic **E**xposure and **R**isk model for **Fum**igants (PERFUM) (http://www.epa.gov/scipoly/sap/2004/index.htm - see Aug. & Sept.) modeling of air residues (with extrapolation to the 1,076 lb ai/A rate) indicates an exceedance of an equivalent LOC at a 0 – 5 meter radius of treatment sites, although this extrapolation has uncertainties. See the Risk Description (Section 5.2) for further details. As seen in **Figure 2.9 (**and further maps in Appendix F), chloropicrin's potential use sites appear to have widespread overlap with and/or proximity to CRLF locations.

2.8 Assessment Endpoints and Measures of Ecological Effect

Assessment endpoints are defined as "explicit expressions of the actual environmental value that is to be protected (U.S. EPA (1992). Selection of the assessment endpoints is based on valued entities (e.g., CRLF, organisms important in the life cycle of the CRLF, and the PCEs of its designated critical habitat), the ecosystems potentially at risk (e.g,. waterbodies, riparian vegetation, and upland and dispersal habitats), the migration pathways of chloropicrin (e.g., runoff, spray drift, etc.), and the routes by which ecological receptors are exposed to chloropicrin-related contamination (e.g., direct contact, etc).

2.8.1. Assessment Endpoints for the CRLF

Assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF, as well as indirect effects, such as reduction of the prey base and/or modification of its habitat. In addition, potential destruction and/or adverse modification of critical habitat is assessed by evaluating potential effects to PCEs, which are components of the habitat areas that provide essential life cycle needs of the CRLF. Each assessment endpoint requires one or more "measures of ecological effect," defined as changes in the attributes of an assessment endpoint or changes in a surrogate entity or attribute in response to exposure to a pesticide. Specific measures of ecological effect are generally evaluated based on acute and chronic toxicity information from registrant-submitted guideline tests that are performed on a limited number of organisms. Additional ecological effects data from the open literature are also considered.

A discussion of the toxicity data selected for calculating risk quotients for this risk assessment, including resulting measures of ecological effect selected for each taxonomic group of concern, is included in Section 4 of this document. A summary of the assessment endpoints and measures of ecological effect selected to characterize potential assessed direct and indirect CRLF risks associated with exposure to chloropicrin is provided in Table 2.6.

Table 2.6 Summary of Assessment Endpoints and Measures of Ecological Effects for Direct and Indirect Effects of Chloropicrin on the California Red-legged Frog

Assessment Endpoint	Measures of Ecological Effects
Aquatic Phase (eggs, larvae, tadpoles, juveniles, and adults)[a]	
1. Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	1a. Most sensitive fish or amphibian acute LC_{50} (chloropicrin: rainbow trout LC_{50}) 1b. Most sensitive fish or amphibian chronic NOAEC (chloropicrin: not available) 1c. Most sensitive fish or amphibian early-life stage data (chloropicrin: not available)
2. Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.,* freshwater fish and invertebrates, non-vascular plants)	2a. Most sensitive fish, aquatic invertebrate, and aquatic plant EC_{50} or LC_{50} (chloropicrin: rainbow trout LC_{50}, *D. pulex* EC_{50}) 2b. Most sensitive aquatic invertebrate and fish chronic NOAEC (chloropicrin: not available)
3. Survival, growth, and reproduction of CRLF individuals via ndirect effects on habitat, cover, and/or primary productivity (*i.e.,* aquatic plant community)	3a. Vascular aquatic plant acute EC_{50} (chloropicrin: not available) 3b. Non-vascular aquatic plant acute EC_{50} (chloropicrin: not available)
4. Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	4a. Distribution of EC_{25} values for monocots (chloropicrin: not available) 4b. Distribution of EC_{25} values for dicots[1] (chloropicrin: not available)
Terrestrial Phase (Juveniles and adults)	
5. Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	5a. Most sensitive bird[b] or terrestrial-phase amphibian acute LC_{50} or LD_{50} (chloropicrin: mammal inhalation toxicity is used) 5b. Most sensitive bird[b] or terrestrial-phase amphibian chronic NOAEC (chloropicrin: mammal inhalation toxicity is used)
6. Survival, growth, and reproduction of CRLF individuals via effects on prey (*i.e.,*terrestrial invertebrates, small terrestrial vertebrates, including mammals and terrestrial phase amphibians)	6a. Most sensitive terrestrial invertebrate and vertebrate acute EC_{50} or LC_{50} [c] (chloropicrin: mammal inhalation toxicity is used) 6b. Most sensitive terrestrial invertebrate and vertebrate chronic NOAEC; (chloropicrin: mammal inhalation toxicity is used)
7. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.,* riparian vegetation)	7a. Distribution of EC_{25} for monocots (chloropicrin: not available) 7b. Distribution of EC_{25} for dicots [2](chloropicrin: not available)

Table 2.6 Summary of Assessment Endpoints and Measures of Ecological Effects for Direct and Indirect Effects of Chloropicrin on the California Red-legged Frog

Assessment Endpoint	Measures of Ecological Effects
Aquatic Phase *(eggs, larvae, tadpoles, juveniles, and adults)*[a]	

[a] Adult frogs are no longer in the "aquatic phase" of the amphibian life cycle; however, submerged adult frogs are considered "aquatic" for the purposes of this assessment because exposure pathways in the water are considerably different that exposure pathways on land.
[b] Birds are used as surrogates for terrestrial phase amphibians.
[c] Although the most sensitive toxicity value is initially used to evaluate potential indirect effects, sensitivity distribution is used (if sufficient data are available) to evaluate the potential impact to food items of the CRLF.
[1] The available information indicates that the California red-legged frog does not have any obligate relationships.

2.8.2. Assessment Endpoints for Designated Critical Habitat

As previously discussed, designated critical habitat is assessed to evaluate actions related to the use of chloropicrin that may alter the PCEs of the CRLF's critical habitat. PCEs for the CRLF were previously described in Section 2.6. Actions that may destroy or adversely modify critical habitat are those that alter the PCEs. Therefore, these actions are identified as assessment endpoints. It should be noted that evaluation of PCEs as assessment endpoints is limited to those of a biological nature (i.e., the biological resource requirements for the listed species associated with the critical habitat) and those for which chloropicrin effects data are available.

Assessment endpoints and measures of ecological effect selected to characterize potential modification to designated critical habitat associated with exposure to chloropicrin are provided in Table 2.e. Adverse modification to the critical habitat of the CRLF includes the following, as specified by USFWS (2006) and previously discussed in Section 2.6:

1. Alteration of water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs.
2. Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.
3. Significant increase in sediment deposition within the stream channel or pond or disturbance of upland foraging and dispersal habitat.
4. Significant alteration of channel/pond morphology or geometry.
5. Elimination of upland foraging and/or aestivating habitat, as well as dispersal habitat.
6. Introduction, spread, or augmentation of non-native aquatic species in stream segments or ponds used by the CRLF.
7. Alteration or elimination of the CRLF's food sources or prey base.

Measures of such possible effects by labeled use of chloropicrin on critical habitat of the CRLF are described in Table 2.7. Some components of these PCEs are associated with physical abiotic features (e.g., presence and/or depth of a water body, or distance between two sites), which are not expected to be measurably altered by use of pesticides. Assessment endpoints used for the analysis of designated critical habitat are based on the adverse modification standard established by USFWS (2006).

Table 2.7. Summary of Assessment Endpoints and Measures of Ecological Effect for Primary Constituent Elements of Designated Critical Habitat

Assessment Endpoint	Measures of Ecological Effect
Aquatic Phase PCEs *(Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)*	
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	a. Most sensitive aquatic plant EC_{50} (chloropicrin: not available) b. Distribution of EC_{25} values for terrestrial monocots (chloropicrin: not available) c. Distribution of EC_{25} values for terrestrial dicots(chloropicrin: not available)
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.[1]	a. Most sensitive EC_{50} values for aquatic plants (chloropicrin: not available) b. Distribution of EC_{25} values for terrestrial monocots(chloropicrin: not available) c. Distribution of EC_{25} values for terrestrial dicots(chloropicrin: not available)
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	a. Most sensitive EC_{50} or LC_{50} values for fish or aquatic-phase amphibians and aquatic invertebrates LC_{50} (chloropicrin: rainbow trout LC_{50}, *D. pulex* EC_{50}) b. Most sensitive NOAEC values for fish or aquatic-phase amphibians and aquatic invertebrates(chloropicrin: not available)
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.,* algae)	a. Most sensitive aquatic plant EC_{50} (chloropicrin: not available)
Terrestrial Phase PCEs *(Upland Habitat and Dispersal Habitat)*	
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	a. Distribution of EC_{25} values for monocots (chloropicrin: not available) b. Distribution of EC_{25} values for dicots (chloropicrin: not available) c. Most sensitive food source acute EC_{50}/LC_{50} and NOAEC values for terrestrial vertebrates (mammals) and invertebrates, birds or terrestrial-phase amphibians, and freshwater fish (chloropicrin: vertebrate inhalation toxicity, rainbow trout LC_{50}, *D. pulex* EC_{50}) .
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	

[1] Physico-chemical water quality parameters such as salinity, pH, and hardness are not evaluated because these processes are not biologically mediated and, therefore, are not relevant to the endpoints included in this assessment.

2.9 Conceptual Model

2.9.1 Risk Hypotheses

Risk hypotheses are specific assumptions about potential adverse effects (i.e., changes in assessment endpoints) and may be based on theory and logic, empirical data, mathematical models, or probability models (U.S. EPA, 1998). For this assessment, the risk is stressor-linked, where the stressor is the release of chloropicrin to the environment. The following risk hypotheses are presumed for this endangered species assessment:

- Labeled uses of chloropicrin within the action area may directly affect the CRLF by causing mortality or by adversely affecting growth or fecundity;
- Labeled uses of chloropicrin within the action area may indirectly affect the CRLF by reducing or changing the composition of food supply;
- Labeled uses of chloropicrin within the action area may indirectly affect the CRLF and/or adversely modify designated critical habitat by reducing or changing the composition of the aquatic plant community in the ponds and streams comprising the species' current range and designated critical habitat, thus affecting primary productivity and/or cover;
- Labeled uses of chloropicrin within the action area may indirectly affect the CRLF and/or adversely modify designated critical habitat by reducing or changing the composition of the terrestrial plant community (i.e., riparian habitat) required to maintain acceptable water quality and habitat in the ponds and streams comprising the species' current range and designated critical habitat;
- Labeled uses of chloropicrin within the action area may adversely modify the designated critical habitat of the CRLF by reducing or changing breeding and non-breeding aquatic habitat (via modification of water quality parameters, habitat morphology, and/or sedimentation);
- Labeled uses of chloropicrin within the action area may adversely modify the designated critical habitat of the CRLF by reducing the food supply required for normal growth and viability of juvenile and adult CRLFs;
- Labeled uses of chloropicrin within the action area may adversely modify the designated critical habitat of the CRLF by reducing or changing upland habitat within 200 ft of the edge of the riparian vegetation necessary for shelter, foraging, and predator avoidance.
- Labeled uses of chloropicrin within the action area may adversely modify the designated critical habitat of the CRLF by reducing or changing dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal.
- Labeled uses of chloropicrin within the action area may adversely modify the designated critical habitat of the CRLF by altering chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.

2.9.2 Diagram

The conceptual model is a graphic representation of the structure of the risk assessment. It specifies the stressor (chloropicrin), release mechanisms, biological receptor types, and effects endpoints of potential concern. The conceptual models for aquatic and terrestrial phases of the CRLF are shown in Figures 2.8 and 2.9, and the conceptual models for the aquatic and terrestrial PCE components of critical habitat are shown in Figures 2.10 and 2.11. Exposure routes shown in dashed lines are not quantitatively considered because the resulting exposures are expected to be so low as not to cause adverse effects to the CRLF.

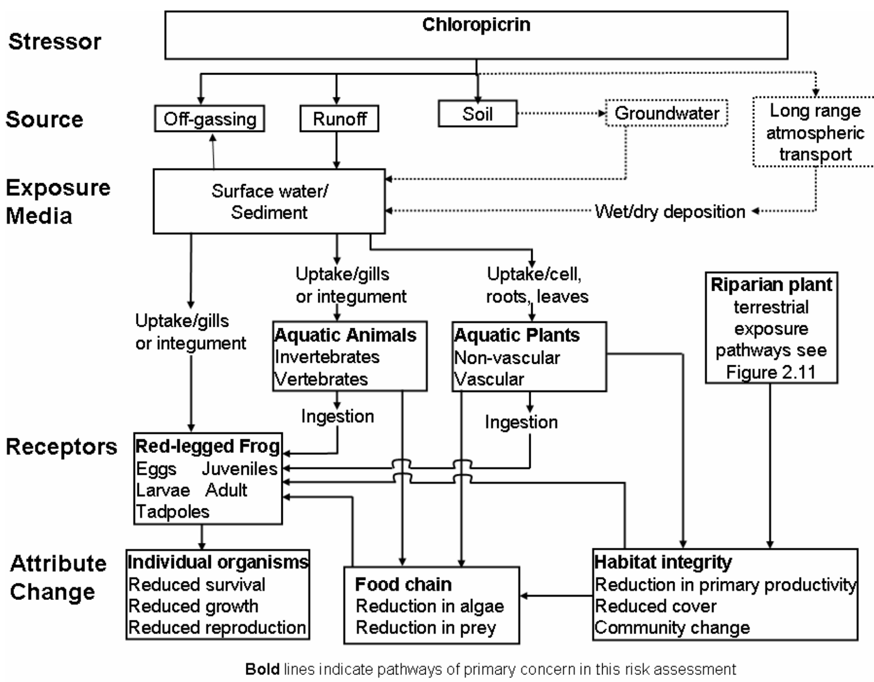


Figure 2.10 Conceptual Model for Chloropicrin Effects on Aquatic Phase of the Red –Legged frog

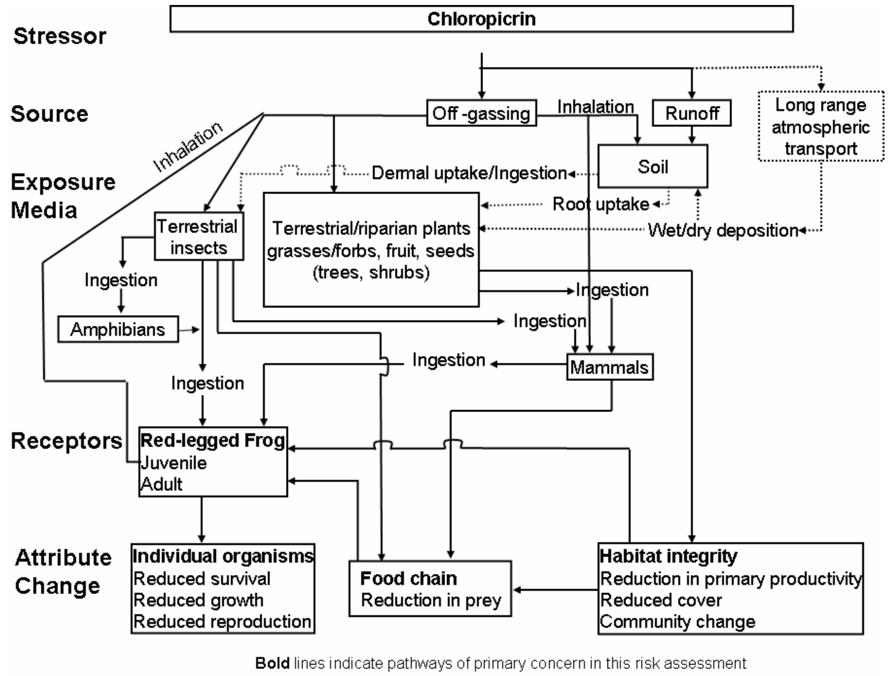


Figure 2.11. Conceptual Model for Chloropicrin effects on Terrestrial Phase of the Red-Legged Frog

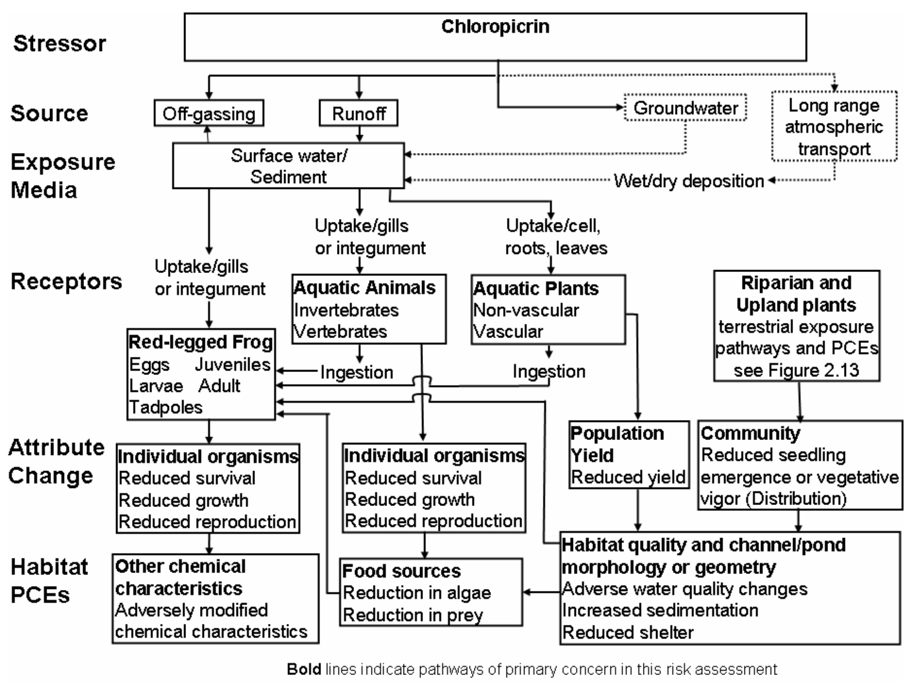


Figure 2.12. Conceptual Model for Chloropicrin Effects on Aquatic component of Red –Legged frog Critical Habitat

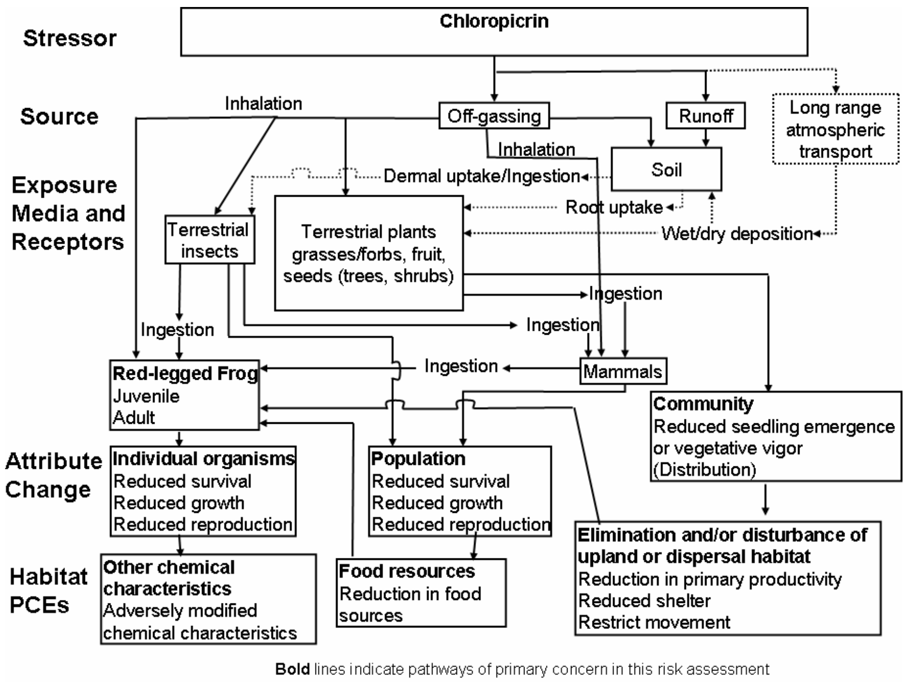


Figure 2.13. Conceptual Model for Chloropicrin Effects on Terrestrial Component of the Red –Legged frog Critical Habitat

2.9.3 Analysis Plan

The objective of EFED's risk assessment is to identify risks to the CRLF from chloropicrin use and make an effects determination. This analysis is based on the quotient method. The risk quotient (RQ) is the ratio of the estimated environmental concentration (EEC) of a chemical to a toxicity test effect (e.g., LC_{50}) for a given species. The RQ as an index of potential adverse effects is then compared to an Agency established Level of Concern (LOC) in order to identify when the potential adverse effect is a concern to the Agency. These LOCs are the Agency's interpretive policy and are used to analyze potential direct and indirect risks to the CRLF. This document presents a sequence of risk assessment methods that include PRZM/EXAMS generated EEC values for aquatic exposure and the Industrial Source Complex: Short-Term Model (ISCTS3) (http://www.epa.gov/scram001/) and PERFUM model simulated air residue values for terrestrial wildlife exposure. The fate, effects, and usage information presented in this document suggest that the focus of the working hypothesis for an environmental risk assessment is that exposure to chloropicrin has the potential to cause acute and chronic effects that may result in reduced survival, reproductive impairment and growth effects to aquatic and terrestrial animals and plant species.

To determine the risk of chloropicrin exposure for the aquatic phase CRLF and its aquatic food supply, PRZM/EXAMS will be used to provide peak concentrations for the RQ calculations. These concentrations will be used in determining RQs to compare to the endangered species level of concern..

Because chloropicrin converts to a gas upon application to the soil, it can potentially pose a risk to terrestrial non-target organisms via the inhalation of the gas. Since the toxicant is a gas, a typical dietary assessment is not conducted. The terrestrial vertebrate risk assessment (including direct effects to the CRLF) is based on inhalation (following a preliminary LD50/sq. ft. screen). It uses air monitoring and modeling, with comparison to mammalian inhalation. Although birds are considered a surrogate for terrestrial-phase amphibians, avian inhalation toxicity data are not available. In the absence of adequate data for plant and terrestrial invertebrate risk quotients, the assessment assumes that chloropicrin potentially poses a risk to these taxonomic groups. This is considered reasonable since chloropicrin is used to control plants and terrestrial invertebrates on the application sites.

Two ECOTOX bibliographies have been reviewed for chloropicrin: the original one (2005) was developed for use in the reregistration review and a new ("refresh") one (2007) was developed to provide an update for the current assessment. Some of these references are considered useful for this assessment and are cited in the text. Appendix D provides additional information, including references not used in the assessment.

The adequacy of the submitted data was evaluated relative to Agency guidelines in prior reregistration risk assessment review. The following identified data gaps for ecological fate and effects endpoints result in a degree of uncertainty in evaluating the ecological risk of chloropicrin in the current assessment.

- No data are available to assess the acute or chronic effects of chloropicrin to birds.
- No data are available to assess the chronic effects of chloropicrin to freshwater fish.
- No data are available to assess the chronic effects of chloropicrin to freshwater invertebrates.
- No data are available to assess the effects of chloropicrin to terrestrial, aquatic, or semi-aquatic plants.
- The available mammal acute inhalation study has deficiencies and is considered non-guideline.
- Studies available on the effects of chloropicrin to freshwater fish and aquatic invertebrates are considered supplemental, with indeterminate toxicity values (i.e., "<").

3.0. Exposure Assessment

3.1 Label Application Rates and Intervals

Chloropicrin is applied as a preplant fumigation by shank injecting or chemigation via drip irrigation into the soil. Application rates and fumigation application methods for the selected crops are summarized in Table 3.1. The crops were largely determined based on major uses of Chloropicrin for agricultural practices in California (Figure 2.5). Additional scenarios were selected for exposure assessment if particular niche locations were found to be vulnerable to RLF habitats. Application rates, timing, and techniques were compiled from actively registered labels and crop scenarios. Rates used in modeling are the maximum allowed rate for that specific crop or crop group. Lower rates may exist, and/or growers may choose to apply lower concentrations than permitted by the label. Chloropicrin labels permit a single application, thus intervals are not included in Table 2.3.

3.2 Aquatic Exposure Assessment

Henry's Law constant (2.05 x 10^{-3} atm-m^3/mol) of chloropicrin suggest that rapid volatilization of chloropicrin from water and soil surfaces is expected to be an important process. Since Tier I model GENEEC is not capable in accounting the loss of the vapor phase of chloropicrin from the fumigated field, Tier II PRZM/EXAMS was used in estimating chloropicrin concentrations in surface water. Estimated environmental concentrations (EEC) of chloropicrin in surface waters were calculated using PRZM v.3.12 (Pesticide Root Zone Model), which simulates runoff and erosion from the agricultural field, and EXAMS v.2.98 (Exposure Analysis Modeling System), which simulates environmental fate and transport in surface water. A graphical user interface developed by EPA (http://www.epa.gov/oppefed1/models/water/) was employed to enter the input values for each model run. A standard ecological pond scenario was used to determine estimated environmental concentrations (EEC) for ecological risk assessment..

Tier II PRZM/EXAMS simulations are run for multiple (usually 30) years and the reported EECs are the concentrations that are expected once every ten years based on the thirty years of daily values generated by the simulation. As such, it provides high-end values of the pesticide concentrations that might be found in ecologically sensitive environments following pesticide application. PRZM/EXAMS simulates a 10 hectare (ha) field immediately adjacent to a 1 ha pond, 2 meters deep with no outlet.

The location of the field is specific to the crop being simulated using site specific information on the soils, weather, cropping, and management factors associated with the scenario. The crop and location of specific scenarios in California is intended to represent a high-end vulnerable site on which the crop is normally grown. Based on historical rainfall patterns, the pond receives multiple runoff events during the years simulated.

3.2.1 Model Inputs

A summary of model inputs of physicochemical and environmental fate properties used in this assessment are provided in Table 3.1 and 3.2. Since chloropicrin is a volatile chemical, additional chemical specific physical parameters like vapor phase diffusion coefficient (DAIR) and enthalpy of vaporization (ENPY) were activated during the PRZM/EXAMS simulation. Intended application methods via shank or drip irrigation are to fumigate subsurface uniformly. Therefore, subsurface chemical application method (CAM 8-chemical incorporated entirely into depth specified by PRZM user) was used in mimicking subsurface fumigation of chloropicrin to simulate its uniform distribution for certain depths through vapor diffusion under the tarp and other sealing methods.

Table 3.1. PRZM/EXAM Input Parameters for Chloropicrin

Parameters	Values & Units	Sources
Molecular Weight	164.39 g $Mole^{-1}$	MRID 43613901
Vapor Pressure 25°C	23.8 mm Hg	Merck Index
Water Solubility @ pH 7.0 and 25°C	1621 mg L^{-1}	MRID 43613901
DAIR	4858.6 cm^2/day	Fuller et al., 1966
ENPY	9.39 kcal/mole (39.3 kj/mol)	Chickos and Acree, 2003
Henry's Law Constant @ 25°C	2.05 X 10^{-3} atm M^3/mole	Kawamoto and Urano, 1989
Hydrolysis Half-Life (pH 7)	Stable	MRID 43022401
Aerobic Soil Metabolism $t_{½}$,	15.71 days	Calculated 90th Percentile MRID#s 43613901 Wilhelm et al., 1996
Aerobic Aquatic metabolism:	15.71 x 2 Days*	EFED Guideline
Anaerobic Aquatic metabolism: for entire sediment/water system	0.05 Days	MRID 43759301
Aqueous Photolysis	1.3 Day	MRID#s 42900201
Soil Water Partition Coefficient	36.05 L Kg^{-1}	EPISUITE**
Pesticide is Wetted-In	No	Product Label

* In absence of aerobic aquatic metabolism half-life, the reported half-lives of aerobic soil metabolism multiplied by 2 according to Guidance for selecting input parameters in modeling for environmental fate and transport of pesticides. Version II. February 28, 2002.
** The EPI (Estimation Program Interface) Suite is a Windows® based suite of physical/chemical property and environmental fate estimation models developed by the EPA's Office of Pollution Prevention Toxics and Syracuse Research Corporation SRC. http://www.epa.gov/opptintr/exposure/docs/updates_episuite_v3.11.htm

There are is an uncertainty in estimating chloropicrin exposure in water bodies due to post-application tarping of the treated area. If tarping is used to minimize the volatilization of chloropicrin, the loading of the chemical through runoff will be limited until the integrity of the tarp is compromised or removed from the field. The present version of PRZM model has limited capabilities of discounting the potential load of applied chemical under a post-application tarp scenario. Therefore, the estimated concentrations of chloropicrin in water bodies may be upper bound under tarp scenarios since the load of chloropicrin from runoff is considered in the PRZM/EXAMS simulation. PRZM also has limited capabilities in capturing the partitions of volatile chemical in air, water and sediment.

3.2.2. PRZM scenarios

Table 3.3 summarizes the crop-specific management practices for all of the assessed uses of chloropicrin that were used in PRZM/EXAMS modeling, including application rates, application method, sealing method and the first application date for each crop.

PRZM scenarios used to model aquatic exposures resulting from applications of specific uses are identified in Table 3.3**.** In cases where a scenario did not exist for a specific use, it was necessary to assign a surrogate scenario. Those surrogates were assigned to be most representative of the use being considered. Justifications for assignments of surrogates are defined below.

Table 3.2. PRZM/EXAMS Input data for Crop management .

Crops	App. Rate (a.i lbs/Acre	App. Method	Depth of Incorporation (cm)	Surface Sealing	App. Date
Strawberry	500	Shank Injection	25	No tarp	December 15
Nursery[1]	1076	Shank injection	25	No tarp	February 15
Potato[2]	400	Shank injection	25	No tarp	February 15
Onion	400	Shank injection	25	No tarp	December 15
Tomato	400	Shank injection	25	No tarp	December 15
Row crop[3]	500	Shank injection	25	No tarp	December 15
Cole crop[4]	400	Shank injection	25	No tarp	December 15
Turf	884.4	Shank injection	25	No tarp	December 15

Table 3.2. PRZM/EXAMS Input data for Crop management .

Crops	App. Rate (a.i lbs/Acre	App. Method	Depth of Incorporation (cm)	Surface Sealing	App. Date
Cucurbits [5]	500	Shank injection	25	No tarp	December 15
Wine Grape[6]	500	Shank injection	76.2	No tarp	December 15

[1] CA Nursery to represent outdoor ornamentals
[2] CA Potato to represent tuber crops (white and sweet potatoes)
[3] CA Row crops to represent pepper
[4] CA cole crop to represent cauliflower, broccoli
[5] CA melon to represent cucurbits
[6] For raspberry, CA wine grape scenario was chosen as surrogate as vineyard agricultural management somewhat resembles that for bramble lots and this scenario is also set in coastal county (Sonoma).

3.2.3 Results

For each PRZM/EXAMS scenario, a shank injection into soil with no tarp scenario was evaluated following the maximum application rates for chloropicrin (Table 3.4). Chloropicrin application via drip irrigation was also evaluated. Since the application rate for drip irrigation is 300 a.i. lbs /Acre or less, the EECs of chloropicrin are lower than the shank injection method (Appendix A). Therefore, the risk estimations are performed using EECs for shank injection method. Acute risk assessments are performed using peak EEC values for a single shank injection application. Chronic risk assessments for aquatic invertebrates and fish are performed using the average 21-day and 60-day EECs, respectively. The variations of chloropicrin levels estimated in surface waters can be traced to chemical loadings into the environmental pond from the PRZM/EXAMS output. Since the chemical input parameters are identical in each PRZM run, the different outputs are entirely dependent upon the different soil parameters used in the corresponding crop scenarios during the PRZM portion of the modeling exercise, as well as the scenario-specific meteorological data. A much higher percentage of pesticide was dissipated in the environment and /or leached below the root zone level for some scenario as compared to other scenarios due to a number of factors such as slope, soil type, moisture content, and the runoff curve numbers used for the different fields. For an example, the chloropicrin loadings into the EXAMS model environment for strawberry were much higher as compared other scenarios, resulting in the larger EECs. Also, there are few infrequent occurrences of very high EECs that were observed in these scenarios, which are related to high rainfall events. The PRZM/EXAMS input and output files from the aquatic ecological exposure assessment are presented in Appendix B.

Table 3.3: Estimated Environmental Concentrations (EECs) of Chloropicrin in surface water for selected crop scenarios of California

Crops (California)	Acute: Peak EEC µg/L	Chronic 21-day Avg. EEC µg/L	Chronic 60-day Avg. EEC µg/L)

Table 3.3: Estimated Environmental Concentrations (EECs) of Chloropicrin in surface water for selected crop scenarios of California

Crops (California)	Acute: Peak EEC µg/L	Chronic 21-day Avg. EEC µg/L	Chronic 60-day Avg. EEC µg/L)
Strawberry	73.36	19.70	6.89
Nursery	41.71	14.48	5.38
Potato	16.97	6.27	2.38
Onion	11.42	3.41	1.31
Tomato	3.11	0.93	0.37
Pepper	3.11	0.67	0.26
Cole Crop	0.12	0.03	0.01
Melon	0.07	0.02	0.01
Turf	0.00	0.00	0.00
Raspberry	0.00	0.00	0.00

Since this compound is very soluble in water and has low adsorption into soil, it can potentially leach into shallow ground water and leaky aquifers and may transport to nearby surface water through runoff and erosion, especially if chloropicrin application coincides with, or is followed soon by a rain event. A critical step in the process of characterizing EECs is comparing the modeled estimates with available surface water monitoring data. Surface water monitoring data from the United States Geological Survey (USGS) NAWQA (http://water.usgs.gov.nawqa) and the California Department of Pesticide Regulation (CDPR) programs were accessed and reviewed. At present time, chloropicrin is not included in the USGS-NAWQA nor CDPR pesticide monitoring survey. However, rapid volatilization of chloropicrin from water and soil surfaces is expected to be an important route of dissipation from the environment. Photolytic degradation of chloropicrin in water is also an important route of dissipation. Based on the data base of pesticides in groundwater (U.S. EPA, 1992), chloropicrin was found at less than 1.00 µg/L in three wells from 15,175 sampled wells in Florida.

3.3 Terrestrial Animal Exposure Assessment

To determine terrestrial exposure to chloropicrin, a deterministic approach was used in estimating exposures around the treated fields. This deterministic approach is based on monitoring data of chloropicrin and the use of EPA's Industrial Source Complex: Short-Term Model (ISCST3) air dispersion model developed by USEPA (U.S.EPA, 1995). ISCST3 is a steady-state Gaussian plume model, which can be used to assess pollutant concentrations from a wide variety of sources. The ISCST3 model is a publicly vetted tool that is currently used by the Agency's Office of Air for regulatory decision making. A number of support documents for this tool can be found at the Agency's website *Technology Transfer Network Support Center for Regulatory Air Models* (http://www.epa.gov/scram001/tt22.htm#isc.) The ISCST3 has been used successfully to simulate fumigant levels in air following the fumigation of warehouses and agricultural fields located in California (Barry et al. 1997). ISCST3 provides useful results because it allows estimation of air concentrations based on changing factors such as application rates, field sizes, downwind distances, wind and weather conditions, and other factors. Using this model for the soil fumigants allows EPA to predict off-site movement given fixed meteorological and other conditions.

The modeling approaches used are based on 24 hours exposure intervals (i.e., 24 hours time-weighted average of monitored air concentration of chloropicrin). Field sizes includes 1-, 5-, 10-, 20-, and 40 acre squares to represent a cross section of the fields that might be fumigated for agriculture use. ISCST3 was used in estimating air concentration using field emission ratio (ratio of the flux rate to the application rate), various sized fields, methods of chloropicrin placement, and different meteorological conditions. The basic approaches to estimate air concentrations using the ISCST3 model are outlined in the Health Effects Division's Draft Standard Operating Procedures (SOPs) for Estimating Bystander Risk from Inhalation Exposure to Soil Fumigant (USEPA,2004). ISCST3 estimated downwind air concentrations using hourly meteorological conditions that include the wind speed and atmospheric stability.

In this assessment, one set of computations was completed using ISCST3 model at varying acreage and atmospheric conditions. The lower the wind speed and more stable the atmospheric environment, the higher the air concentrations were observed near the treated areas. The outputs were then scaled to appropriate emission ratios and application rates assuming stable weather condition. Table 3.4 reflects a wide variety of application rates and methods as well as the estimated concentrations of chloropicrin in air at the edge of a 40 acre field under stable weather condition. The estimated maximum concentration of 0.019 mg/L (19037 $\mu g/m^3$) was used in calculating inhalation exposure for terrestrial organisms. California Fumigant Permit conditions and detailed input assumptions and model results are described in the HED's Draft Chapter on Non-Occupational Risks Associated with Chloropicrin (USEPA, 2005c).

The specific choices for inputs for the ISCST3 model calculations contribute the associated uncertainties in the results. For example, the key input factors for pre-plant agricultural uses were field size, flux/emission rates, atmospheric stability, and windspeed. Wind direction is another factor that also should be considered. The field sizes used by the Agency in this assessment were 1 to 40 acres which is well within the range of what could be treated on a daily basis.

There are uncertainties associated with point estimates of flux/emission rates for specific application techniques which is another varying factor. The flux rates that were used have been calculated by the Agency and they compare reasonably well with those calculated by the study investigators (USEPA, 2005c). However, there is a large distribution of flux rates which is a phenomena inherent in the nature of these types of data.

Table 3.4. ISCTS3 estimated air concentrations of chloropicrin at various distances from the edge of 40 acres fumigated fields (meter) under several application methods

Application Methods	Tarping	Application Rate (lbs/Acre)	Concentraton Chloropicrin in Air (μg/m^3)			
			0 M*	25 M	50 M	100 M
Shank Injection Broadcast	Yes	350	19037	10951	8915	6876
Shank Injection Broadcast	No	175	15864	9126	7429	5730
Shank Injection Raised Bed	Yes	350	11319	6511	5301	4088
Shank Injection Raised Bed	No	175	11491	6610	5381	4150
Drip Irrigation	Yes	300	4373	2515	2048	1580

* Distances (meter) from the edge of the field

The values used for this assessment yield conservative air concentration estimates because considering a constant flux rate does not allow for diurnal/nocturnal changes that may occur, which when coupled with the appropriate wind speed and stability category, can result in lower concentrations. The meteorological inputs also will provide a conservative estimate of exposure because the wind direction is considered to be perpendicular (pointed downwind) to the treated field for the entire 24 hours represented in the calculation. This is not a normal situation in the atmosphere for most locations. There is normally a prevailing wind with directional changes over the course of a typical day, especially when diurnal and nocturnal differences are noted. Overall, the Agency believes that the approach used to evaluate potential exposures from a known area source can be considered conservative. It is believed, however, that the range of selected input values and outputs represent what could reasonably occur in agriculture given proper field and climatological conditions.

3.3.1 Terrestrial Exposure Monitoring Data

Background concentrations (concentrations in air at sites remote from areas of recent application) of chloropicrin in air were below the analytical detection limit (0.03 μg/m^3) based on upwind or off target monitoring by the California Air Resources Board (CARB 2004, 2003). Thus, as predicted by its short atmospheric half life, the detection and measurement of chloropicrin in air is largely a local phenomenon. Measured concentrations would be expected to vary greatly with time and distance from areas of application, and with size and application rates to the areas receiving treatment.

In monitoring conducted in urban and rural communities near agricultural sites where chloropicrin was being applied in Monterey and Santa Cruz Counties, the California Air Resources Board observed concentrations of chloropicrin to range from undetected (<30 $\mu g/m^3$) to 14.00 $\mu g/m^3$, with a range of 8-week average concentrations of 0.41 to 2.27 $\mu g/m^3$. Chloropicrin was undetected in only 7 of 192 samples (CARB 2004). Similar monitoring in Kern County found much lower levels of chloropicrin (<0.03 – 0.75 $\mu g/m^3$, 8-week averages ranging from <0.03– 0.04 $\mu g/m^3$), but chloropicrin was not being used extensively during the season at that location (CARB 2004). Most of the samples collected (185 of 198) were below the detection limit (<0.03 µg/m3). An assessment of chloropicrin risks to residents in rural communities estimated a mean 24 hour concentration of 0.21$\mu g/m^3$ for residents during periods of chloropicrin application to nearby agricultural areas (Lee et al. 2002). Ambient chloropicrin concentrations are presented in **Table 3.5**.

Table 3.5. Ambient air concentrations of chloropicrin near fumigated fields.

Concentration ($\mu g/m^3$)[1]	Exposure Type	Location	Date	Reference
0.21 ± 0.59 <85 - 4600	Rural residential	Kern Co., CA	1996	Lee et al. 2002
<0.09	Urban residential	Kern Co., CA	1996	Lee et al. 2002
<0.03 -14.00 daily, 8 week average = 0.41 – 0.00	Rural residential	Monterey, Santa Cruz Co., CA	2001	CARB 2004
<0.03 – 3.30 daily, 8 week average = 0.66	Urban residential	Monterey, Santa Cruz Co., CA	2001	CARB 2004
<0.03 – 0.75, 8 week average = <0.04	Rural residential	Kern Co., CA	2001	CARB 2003

[1] mg/L = $\mu g/m^3$/1,000, 000

4.0 Effects Assessment

Effects characterization describes the potential effects a pesticide can produce in an aquatic or terrestrial organism. This characterization is typically based on studies that describe acute and chronic toxicity for various aquatic and terrestrial animals and plants. However, data for chloropicrin, while relatively extensive for mammals, are very limited otherwise. For mammals, acute studies are usually limited to Norway rat or the house mouse. The risk assessment assumes that avian and terrestrial phase amphibian toxicities are similar. The same assumption is used for fish and aquatic phase amphibians (EPA, 2004).

In general, categories of acute toxicity ranging from "practically nontoxic" to "very highly toxic" have been established for aquatic organisms (based on LC_{50} values), terrestrial organisms (based on LD_{50} values), avian species (based on LC_{50} values), and non-target insects (based on LD_{50} values for honey bees) (EPA 2001).

4.1 Evaluation of Aquatic Ecotoxicity Studies

The most sensitive acute toxicity reference values associated with chloropicrin exposure to aquatic organisms are summarized in **Table 4.1.** No chronic data are available.

Table 4.1. Chloropicrin toxicity reference values (TRVs) (ppb of active ingredient) for aquatic organisms

Exposure Scenario	Species	Exposure Duration	Toxicity Reference Value (ppb a.i.)	Reference
Freshwater Fish				
Acute	Rainbow trout	48/96 hours	LC_{50} < 16.98 ppb (very highly toxic)	FTLR 425/McCann/1971 Supplemental Study
Chronic	NA	NA	NA	NA
Freshwater Invertebrates				
Acute	*Daphnia pulex*	48 hours	LC_{50} <71 ppb (very highly toxic)	MRID 130704 Supplemental Study
Chronic	NA	NA	NA	NA
Aquatic Plants				
Acute	NA	NA	NA	NA

NA = Data appropriate for quantitative use are not available.

4.1.1 Acute Toxicity to Freshwater Fish

The acute toxicity of chloropicrin to freshwater fish was evaluated in rainbow trout and bluegill sunfish, with LC_{50} values of < 16.98 ppb (very highly toxic) and < 105 ppb (at least highly toxic), respectively. The values are expressed as "less than" the numeric value, since chloropicrin is highly volatile and measured residues were not provided. The rainbow trout value is used as the toxicity value for assessing acute risks to fish from exposure to chloropicrin.

4.1.2 Acute Toxicity to Freshwater Invertebrates

The acute toxicity of chloropicrin to aquatic invertebrates has been assessed in *Daphnia pulex*, with a 48-hour LC_{50} value of < 71 ppb (very highly toxic). The value is expressed as "less than" the numeric value, since chloropicrin is highly volatile and measured residues were below the Level of Quantitation at the lowest four test levels at 48 hours. Although residues were below the Level of Quantitation, 10 - 20% mortality of daphnids occurred at these test levels.

4.2 Evaluation of Terrestrial Ecotoxicity Studies

The toxicity endpoints used to characterize risks of chloropicrin exposure to birds and mammals are summarized in **Table 4.2.**

4.2.1. Mammalian Species

Based on the results of an acute oral toxicity study in rats (**Table 4.2)**, chloropicrin is highly toxic to mammals. The acute oral value is used in this risk assessment only for the LD50 per square foot preliminary analysis. The acute inhalation and chronic inhalation endpoints are used for the inhalation analyses.

Table 4.2. Toxicity reference values (TRVs) for terrestrial species for chloropicrin

Exposure Scenario	Species	Exposure Duration	Toxicity Reference Value	Reference
Mammals				
Acute oral	Rat	Single oral dose	LD_{50} = 37.5 mg/kg (highly toxic)	MRID 05014376 Acceptable/Guide-line
Acute inhalation	Rat	4-hour inhalation	LC_{50} = 17 ppm (M) and 19 ppm (F) [conv. to mg/L: Section 5.2]	MRID 45117902 Acceptable/Non-guideline
Inhalation Developmental Toxicity	Rabbit	6 hrs./day on days 7 – 29 (inhalation)	NOAEL = 0.4 ppm (0.003 mg/L)	MRID 42740601 Acceptable/ guideline
Birds				
Acute	No Data			
Chronic	No Data			

4.3 Use of Probit Slope Response Relationship to Provide Information on the Endangered Species Levels of Concern

The Agency uses the probit dose response relationship as a tool for providing additional information on the potential for acute direct effects to individual listed species and aquatic animals that may indirectly affect the listed species of concern (U.S. EPA, 2004). As part of the risk characterization, an interpretation of the acute LOC for listed species (or specific RQ) is discussed. This interpretation is presented in terms of the chance of an individual event (*i.e.*, mortality or immobilization) should exposure at the LOC (or for a specific RQ) actually occur for a species with sensitivity to chloropicrin on par with the acute toxicity endpoint selected for RQ calculation. To accomplish this interpretation, the Agency uses the slope of the dose response relationship (where available) from the toxicity study used to establish the acute toxicity measures of effect for each taxonomic group that is relevant to this assessment. The individual effects probability associated with the LOC (or specific RQ) is based on the mean estimate of the slope and an assumption of a probit dose response relationship. In addition to a single effects probability estimate based on the mean, upper and lower estimates of the effects probability are also provided to account for variance in the slope, if available. The upper and lower bounds of the effects probability are based on available information on the 95% confidence interval of the slope. A statement regarding the confidence in the estimated event probabilities is also included. Studies with good probit fit characteristics (*i.e.*, statistically appropriate for the data set) are associated with a high degree of confidence. Conversely, a low degree of confidence is associated with data from studies that do not statistically support a probit dose response relationship. In addition, confidence in the data set may be reduced by high variance in the slope (i.e., large 95% confidence intervals), despite good probit fit characteristics. In the event that dose response information is not available to estimate a slope, a default slope assumption of 4.5 (lower and upper bounds of 2 to 9) (Urban and Cook, 1986) is used.

Individual effect probabilities are calculated using an Excel spreadsheet tool IECV1.1 (Individual Effect Chance Model Version 1.1) developed by the U.S. EPA, OPP, Environmental Fate and Effects Division (June 22, 2004). The model allows for such calculations by entering the mean slope estimate (and the 95% confidence bounds of that estimate) as the slope parameter for the spreadsheet. The acute aquatic or terrestrial endangered species animal LOC (or specific RQ) is entered as the level to be evaluated. For chloropicrin, a default slope of 4.5 is used to assess the mammal acute inhalation toxicity (see Section 5.2.5 for further details, including probabilities of individual effects).

5.0 Risk Characterization

5.1 Risk Estimation - Integration of Exposure and Effects Data

5.1.1 Direct Effects

5.1.1.1 Aquatic Phase CRLF

Risk to fish is used as a measure of ecological effect for direct effects to aquatic phases of the CRLF. Risk quotients are presented in **Table 5.1**. The risk quotients are calculated using the toxicity data from **Table 4.1** and EECs from PRZM/EXAMS summarized in **Table 3.2**. For assessing acute risks, the 24-hour peak concentration is used. Chronic toxicity data are not available to calculated chronic risk quotients.

Table 5.1 Risk Quotients (RQs) for chloropicrin for direct effects to aquatic phase CRLF (rainbow trout as surrogate)

Exposure Scenario	Exposure (ppb)	Toxicity Reference Value (ppb)	Risk Quotient
Freshwater Fish			
Acute risk			
Strawberry	73.36	<16.98	>4.32*
Nursery	41.71	<16.98	>2.46*
Potato	16.97	<16.98	>0.99*
Onion	11.42	<16.98	>0.67*
Tomato and Pepper	3.11	<16.98	>0.18*
Cole Crop	0.12	<16.98	>0.007**
Melon	0.07	<16.98	>0.004**
Turf	0.00	<16.98	0
Raspberry	0.00	<16.98	0

*Exceeds acute endangered species LOC (≥ 0.05)
**May exceed acute endangered species LOC (see text)

The strawberry exposure scenario (using 500 lb ai/A) produces the highest RQ, as shown in Table 5.1. However, there are a variety of other rates that could be used on this crop. One label (8622-43) that cites "all crops" lists an application rate of 485 – 1,076 lb ai/A, followed by a "Suggested" rate for strawberries of 320 – 500 lb ai/A. Thus, the 1, 076 lb ai/A rate could potentially be used under this label. The following bar graph shows the RQ (>9.3) for this rate, as well as for four other rates (for comparison): the maximum used in California (PUR data); the maximum "suggested" rate on label 8622-43 (500 lb ai/A); the Chloropicrin Task Force supported maximum rate (350 lb ai/A); and the maximum average rate used in California during 2002 to 2005 (US EPA-BEAD 2007 (PUR data). As can be seen, all exceed the endangered species LOC of 0.05 (Figure 5.1).

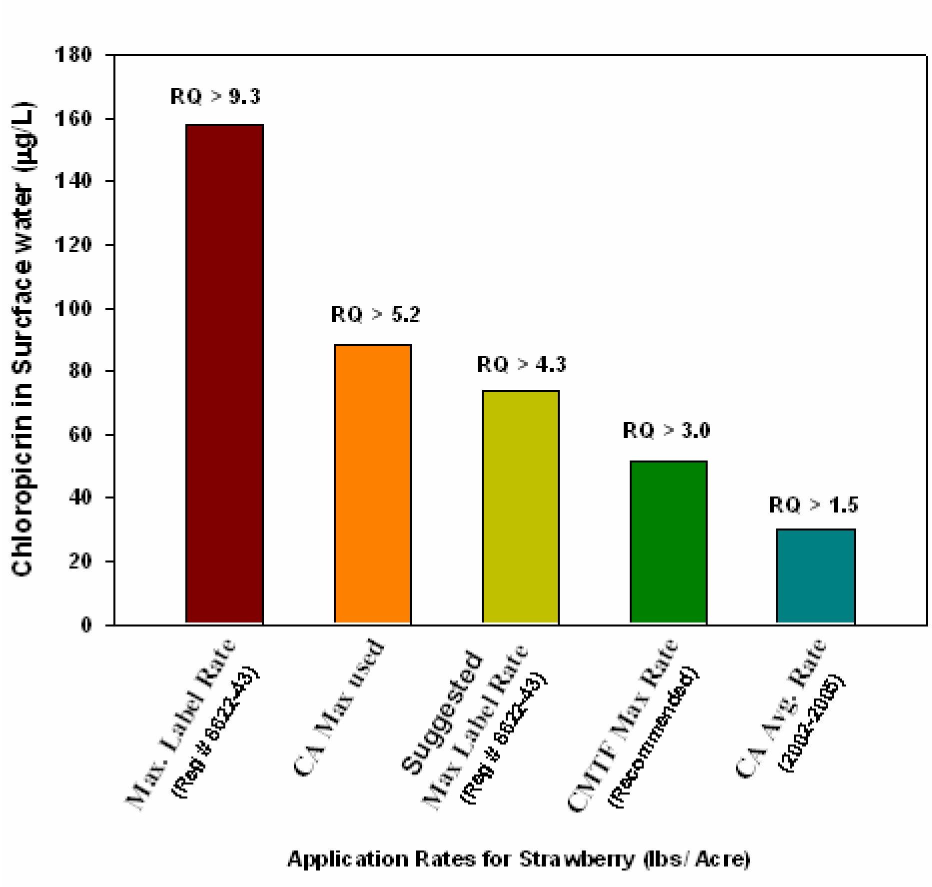


Figure 5.1. Various Application Rates and the Estimated RQs for California Strawberry

There is an uncertainty in estimating chloropicrin exposure in water bodies due to post-application tarping of the treated area. If tarping is used to minimize the volatilization of chloropicrin, the loading of the chemical through runoff will be limited until the integrity of the tarp is compromised or removed from the field. The present version of PRZM model has limited capabilities of discounting the potential load of applied chemical under a post-application tarp scenario. Therefore, the estimated concentrations of chloropicrin in water bodies may be upper bound under tarp scenarios since the load of chloropicrin from runoff and erosion is considered in the PRZM/EXAMS simulation. PRZM also has limited capabilities in capturing the partitions of volatile chemical in air, water and sediment. Therefore, PRZM/EXAMS estimated exposure values may contribute upper bound LOCs for the aquatic organisms.

As shown by the asterisks in Table 5.1 above, at least five of the nine modeled sites (strawberry, nursery, potato, onion, and tomato) exceed the endangered species LOC of 0.05 used to evaluate direct effects to the CRLF (based just on the numeric portion of the risk quotients shown). Given that all risk quotients are expressed as “greater than” these numeric values, all scenarios with exposure greater than zero could potentially exceed LOCs.

Newly-submitted data on chloropicrin have been recently received in response to reregistration review of this chemical. These include data on acute toxicity to rainbow trout, bluegill sunfish, and *Daphnia magna*. These data are currently under review. If valid, they will likely reduce uncertainty with the aquatic risk assessment. Based on the reported results, toxicity values are largely consistent with those used in this assessment. The rainbow trout is reported to be the most sensitive and the daphnid the least sensitive of the three species, as at present. For the daphnid, the reported toxicity value is higher (ie, less sensitive) than that currently used, and thus may (if confirmed) not change the assessment. The bluegill is reportedly less sensitive than the trout and thus would (if confirmed) not be used for risk quotients. The reported rainbow trout toxicity value (4.8 µg/l, or ppb) is less than the numeric portion of the value currently used (< 16.98 ppb) and, if confirmed, would thus be used for risk assessment and increase certainty. However, LOCs are already exceeded using the current value and thus overall conclusions would likely remain largely the same.

5.1.1.2 Terrestrial Phase

Direct effects to terrestrial phase CRLF are estimated based on exposure to off-gassed chloropicrin, the expected main route of exposure. Prior to an inhalation analysis, a preliminary screen based on total available pesticide is conducted. Birds are generally used as a surrogate for terrestrial phase amphibians. However, avian LD_{50} data needed for this screen are not available, and thus the following analysis based on mammals serves as a surrogate for birds and, in turn, the CRLF.

The established LD_{50}/square foot risk assessment method for mammals (EPA, 2004) is used as a preliminary risk calculation. This method is considered to cover all routes of exposure, although it uses an acute oral toxicity value. It is typically used for granular and similar products, but it is considered acceptable for use as a screen for chloropicrin. Uncertainties of the method, in general, include 1) non-oral routes of exposure may be either more or less hazardous than the oral route, and 2) an organism would not typically take up all the toxicant from any given square foot, and the amount of toxicant in this unit of area may be more or less than that which an organism receives overall as a dose. For evaluating exposure to a highly volatile chemical applied below ground, there is added uncertainty since all the chemical applied is not available at the surface at any one time, for example. Its value for the present assessment is as a preliminary screen to confirm whether a refined route-specific (e.g., inhalation) analysis is appropriate. That is, the LD_{50}/square foot calculations reflect <u>all</u> routes of exposure. Routes of exposure that are most appropriate (i.e., inhalation for fumigants) can then be evaluated, if the necessary exposure and toxicity data are available.

A range of application rates, from 400 lb ai/A (onion) to 1076 lb ai/A ("all crops") was assessed. At 400 lb ai/A of chloropicrin, there would be 4,165 mg ai/square foot (given 43,560 square feet/A and 453,590 mg/lb). This exposure amount is divided by the product of acute oral LD50 for mammals (37.5 mg/kg) and body weight of mammal (in kg) to calculate risk quotients. Three mammal body weights were assessed: 15 g, 35 g, and 1000 g. The resulting risk quotients (LD_{50s}/sq. ft.) for these three sizes of mammals are 7,404; 3,173; and 111, respectively. At 1,076 lb ai/A the RQs are 19,918; 8,536; and 299, respectively. These all far exceed the terrestrial acute endangered species LOC of 0.1. Thus, this preliminary screen indicates a potential for concern for risk to wild terrestrial vertebrates (including direct effects to terrestrial-phase CRLF), and a need for further analysis.

The main route of terrestrial vertebrate exposure is likely to be from inhalation of chloropicrin off-gassing from treated fields. Mammalian inhalation toxicity data are available. However, an established LOC based on inhalation exposure is not available. Nevertheless, an inhalation risk concern for terrestrial vertebrates has been identified. See the Risk Description for the more refined assessment of risk based on inhalation exposure.

5.1.2 Indirect Effects

5.1.2.1 Aquatic Phase CRLF

Indirect effects to aquatic phases of the CRLF via the food supply are estimated via risk quotients using fish, aquatic invertebrates, and aquatic plant toxicity data, where available (see Section 2.8). Fish RQs are shown above in Table 5.1, where at least five of the nine scenarios exceed the LOC. Aquatic plant toxicity data are not available for this calculation. Freshwater invertebrate RQs are presented in **Table 5.2**. The risk quotients are calculated using the toxicity data from **Table 4.1** and EECs from PRZM/EXAMS summarized in **Table 3.4**. For assessing acute risks, the 24-hour peak concentration is used. Chronic toxicity data are not available to calculate chronic risk quotients.

Indirect effects to aquatic phases of the CRLF via effects on habitat, cover, and/or primary productivity and via effects to riparian vegetation are estimated via risk quotients using aquatic and terrestrial plants, respectively. Plant toxicity data suitable for these calculations are not available.

Table 5.2 Risk Quotients (RQs) for chloropicrin for acute exposures of aquatic invertebrates

Exposure Scenario	Exposure (ppb)	Toxicity Reference Value (ppb)	Risk Quotient
Freshwater Aquatic Invertebrates			
Acute risk			
Strawberry	73.36	<71	>1.03*
Nursery	41.71	<71	>0.59*
Potato	21.21	<71	>0.30*
Onion	11.42	<71	>0.16*
Tomato and Pepper	3.11	<71	>0.04**
Cole Crop	0.12	<71	>0.002**
Melon	0.07	<71	>0.001**
Turf	0.00	<71	0
Raspberry	0.00	<71	0

*Exceeds acute endangered species LOC ($\geq$ 0.05)
**May exceed acute endangered species LOC (see text)

As shown in the table above, at least four of the nine modeled sites (strawberry, nursery, potato, and onion) exceed the endangered species LOC of 0.05 used to evaluate effects to the aquatic invertebrate prey base of the CRLF (based just on the numeric portion of the risk quotients shown). Given that all risk quotients are expressed as "greater than" these numeric values, all scenarios with exposure greater than zero could potentially exceed LOCs.

5.1.2.2 Terrestrial Phase CRLF

Indirect effects to terrestrial phases of the CRLF via effects on prey are estimated via risk quotients using terrestrial invertebrates and vertebrates (see Section 2.8). Data appropriate for terrestrial invertebrate RQs are not available. RQs for terrestrial vertebrates (preliminary screen) are shown above in Section 5.1.1.

Indirect effects to terrestrial phases of the CRLF via effects on riparian vegetation are estimated via risk quotients using terrestrial plants (see Section 2.8). Data appropriate for terrestrial plant RQs are not available.

5.1.3 Adverse Modification to Designated Critical Habitat

Assessment endpoints and measures of ecological effects to PCEs of Designated Critical

Habitat are described in Section 2.8.2. Measures of ecological effects include aquatic and terrestrial plant toxicity, fish and aquatic invertebrate toxicity, and terrestrial vertebrate and invertebrate toxicity. Data appropriate for non-target plant risk quotient calculations and non-target terrestrial invertebrate risk quotient calculations are not available. Risk quotients for fish and aquatic invertebrates are shown above in Tables 5.1 and 5.2, respectively. RQs for terrestrial vertebrates (preliminary screen) are shown above in Section 5.1.1.

5.2 Risk Description

The risk description provides further discussion of risk estimates provided in Section 5.1 above, provides the detailed terrestrial vertebrate inhalation risk calculations and discussion previously mentioned, and provides additional lines of evidence considered in determining potential effects to the CRLF. Finally, it synthesizes an overall conclusion regarding the likelihood of direct and indirect effects to the CRLF and effects to Designated Critical Habitat.

5.2.1 Direct Risk to Aquatic-phase CRLF and Indirect Risk to CRLF via Effects on their Fish and Aquatic Invertebrate Prey

Chloropicrin has the potential to reach surface water bodies. EECs to determine the acute risk to aquatic organisms were estimated using PRZM/EXAMS models with nine selected California-specific scenarios, to represent the numerous agricultural and non-agricultural sites for which chloropicrin is registered for use in California. The chloropicrin aquatic exposure estimates varied due to the different conditions (e.g., rainfall, soil temperature, slope) for each modeled location. Also, for a given amount of chloropicrin transported to a water body, there is expected to be greater aquatic organism exposure in colder waters, since the Henry's Law Constant will be lower in colder waters, resulting in lower volatilization (and conversely, lower exposure in warmer waters).

For fish (surrogate for aquatic-phase CRLF), risk quotients are considered to exceed the endangered species acute LOC (0.05) for five of the nine California-specific scenarios used.

For aquatic invertebrates (food for aquatic-phase CRLF), risk quotients are considered to exceed the aquatic acute endangered species LOC (0.05) for four of the nine California-specific scenarios used.

In these cases, the LOCs are exceeded based just on the numeric value of the risk quotients. As explained earlier, given that all risk quotients are expressed as "greater than" these numeric values, all scenarios with RQs greater than zero for both taxonomic groups could potentially exceed LOCs. Also, only a select number of use sites have been modeled, and it is likely that other use sites would have aquatic exposures in the range of the sites modeled. Thus, it cannot be determined that any use site with estimated exposure greater than zero does not exceed acute LOCs. However, in addition to the uncertainty concerning the toxicity of chloropicrin to aquatic animals (i.e., chloropicrin is apparently more toxic than indicated in the studies), there are also substantial uncertainties concerning exposure modeling values, as described earlier.

5.2.2 Direct Risk to Terrestrial Phase CRLF and Indirect Risk to CRLF via

Effects on Terrestrial Prey

Chloropicrin is highly volatile and can off-gas from treated fields and potentially expose a range of nontarget terrestrial organisms in its path. Given the broad spectrum use of chloropicrin, it is assumed that most living organisms in the treated fields (including any beneficial insects and/or burrowing mammals) would be at high risk of mortality.

The risk to terrestrial phase CRLF and to terrestrial animal prey items of the CRLF is expected to largely depend on inhalation exposure to off-gassed chloropicrin from treated sites. Inhalation toxicity data are only available for mammals.

A screening-level method (LD50/ft^2) was used as a preliminary step to assess risks of the pesticide to terrestrial vertebrates. This method has most frequently been applied to pesticide application scenarios involving granular formulations, seed treatments, and baits. The method has not been generally applied to situations involving highly volatile compounds, but remains the Agency's screening index for this type of use, considering all possible routes of exposure. This LD50/ft^2 method is an index that does not systematically account for exposures from each potential route, but considers the overall potential for exposure given a bioavailable amount of pesticide conservatively related to the mass applied per unit area at the treatment site. If this index were not exceeded, there would be no need to refine it further (see the uncertainty discussion in the Risk Estimation section above). Three mammal body weights were assessed: 15g, 35g, and 1000g. At a 400 lb ai/A application rate, the resulting risk quotients (LD50s/sq. ft.) for these three sizes of mammals are 7,404; 3,173; and 111, respectively. At 1,076 lb ai/A the RQs are 19,918; 8,536; and 299, respectively (see the Risk Estimation section above). These far exceed the terrestrial acute endangered species LOC of 0.1. Thus, this preliminary screen indicates a potential for concern for risk to wild mammals (surrogate for birds which in turn are surrogate for the CRLF; wild mammals are also prey items of the terrestrial phase CRLF), and a refined analysis based specifically on inhalation exposure is described below.

Available ambient monitoring data for chloropicrin indicates a maximum ambient air residue of 14.00 $\mu g/m^3$ (see **Table 3.5**). This is equivalent to a chloropicrin air concentration of 0.000014 mg/L. A comparison of this air concentration with available mammalian acute inhalation effects data (LC_{50} of 0.114 mg/L) would indicate a risk quotient of 0.00012, well below any LOC.

Monitoring data for a limited number of application sites is not necessarily predictive of all site conditions where the pesticide may be used. Also, most monitoring data are for samples collected at least 1.0 m above the ground, often higher. This height is above the level for many ground-dwelling mammals and ground-feeding birds, as well as the terrestrial phase CRLF. It is reasonable to assume a gradient of concentrations at the treatment site, with higher concentrations of chloropicrin occurring closer to the ground. This would be especially applicable to those times that a tarp is not used (and animals would be more likely to be on the soil surface of the treated field). Thus, modeling has been used to attempt to estimate residues closer to the field and ground. However, the model calculations do not specifically produce on-field, ground surface level air residues.

The ISCST3 model estimated concentrations were used in calculating the concentrations on the edge of the field from a field application of chloropicrin. The highest air concentration of 0.019 mg/L was estimated. With an acute mammal inhalation LC_{50} of 17 ppm (0.114 mg/L), the risk quotient for this modeled concentration is 0.17 (0.019 /0.114).

There is not an established LOC threshold expressly for the interpretation of RQs calculated for inhalation exposure risks. However, if the existing LOC values for acute mammalian wildlife risk were used to evaluate such RQs, the above analysis based on modeling at the edge of the field (risk quotient of 0.17) would suggest that at least some uses of chloropicrin could exceed the terrestrial acute endangered species LOC (0.1). The modeling is based on a 350 lb ai/A application rate. Existing labeling allows up to 1, 076 lb ai/A (on at least one label). Extrapolating to this maximum rate would produce a risk quotient of 0.52. Although such extrapolation adds uncertainty over the exact exposure level, there is little doubt that the exposure and RQ will be higher with the substantially higher rate, if all other conditions are the same. Based on the above analysis with mammals, it appears that terrestrial phase CRLF as well as vertebrate prey of the CRLF could be acutely adversely affected by chloropicrin.

The Probabilistic Exposure and Risk model for Fumigants (PERFUM) was used in this assessment to refine the potential risks to terrestrial organisms from chloropicrin uses. PERFUM was developed to address the issue of bystander exposures to fumigants following agricultural applications. PERFUM incorporates actual weather data and flux distributions estimates and accounts for changes relative to the time of day and altering conditions. It is also capable of providing distributional outputs for varying receptor locations and using varied statistical approaches. Appendix B provides PERFUM model information and results. Twelve different application scenarios (e.g., broadcast, bedded, tarped, untarped, drip irrigation, Bakersfield/Ventura sites, application rates up to 350 lb ai/A) were modeled. The highest 90^{th} percentile air residue across these scenarios is 4,219 µg/ m^3, for 40 acres, broadcast, untarped, 0 – 5 meters radius from the field edge, 8 – 12 hours after application at 175 lb ai/A. The risk quotient for terrestrial vertebrates (using mammal data) for this modeled concentration is 0.037 (0.004219 mg/L / 0.114 mg/L), below the 0.1 endangered species LOC. Extrapolating to the maximum application rate (1,076 lb ai/A) as above, produces a risk quotient of 0.11, above the LOC. Although such extrapolation adds uncertainty over the exact exposure level, there is little doubt that the exposure and RQ will be higher with the substantially higher rate, if all other conditions are the same. However, modeling is based on shallow injection data and cannot be extrapolated to the labels requiring deeper injection, for example. See Section 5.2.5 for probabilities of individual effect at the 0.1 equivalent LOC.

The above assessment is limited to acute effects and exposure windows. Terrestrial-phase CRLF as well as its vertebrate prey (i.e., small mammals) may have home ranges in the treatment area and may be exposed more than once as the result of chloropicrin use on multiple fields over multiple days in a geographic area. Given that the rabbit inhalation developmental toxicity NOAEL for chloropicrin is 0.003 mg/L (with the developmental LOAEL of 0.008 mg/L based on abortions and decreased fetal weights), lower than the acute inhalation endpoint, the potential for a concern for developmental/reproductive effects was investigated. Given the short atmospheric half-life of chloropicrin described earlier, it appears unlikely that more than acute exposure would occur from any single application of chloropicrin. However, multiple fields may be treated in an area over a number of days. Therefore, there still exists a potential that terrestrial phase CRLF and/or its vertebrate prey within an area of multiple treated fields may be exposed to chloropicrin emissions on a repeated basis over time. Comparison of the previously cited maximum ambient air residues (0.000014 mg/L) to the 0.003 mg/L NOAEL above implies that ambient air residues are likely to be well below developmental effect levels. Thus, it does not appear (based on mammal data) that the CRLF is likely to be affected directly by chronic inhalation effects (uncertainties include those due to extrapolation) or indirectly by chronic effects to the terrestrial vertebrate portion of their prey base.

The above analysis is based on mammalian toxicity data for the inhalation route. Birds are considered to be surrogates for amphibians, including the CRLF. A similar analysis could be performed for birds, if the avian toxicity were available. However, no inhalation toxicity data for chloropicrin are available for birds. If acute toxicity by the oral route were available for both mammals and birds, an evaluation of the relative sensitivity via the oral route might be extrapolated to the inhalation route to estimate an acute inhalation endpoint for birds. However, no acute oral LD_{50} data for chloropicrin are available for birds. Therefore, an assumption of equivalent sensitivity between birds and mammals for exposure through inhalation is being employed. This interspecies extrapolation may underestimate the risk to birds, given higher respiration rates for birds versus mammals, and physiological differences in the avian lung that would tend to favor higher diffusion rates across the lung membrane when compared to mammals. Therefore, inhalation analyses that suggest a potential for adverse effects in mammals would also suggest potential risks to birds via the inhalation route, but analyses not indicating risk to wild mammals would not necessarily be true for birds also. Because of generally lower metabolism of amphibians relative to birds, they may be less sensitive than birds to inhaled toxicants; however, they are less mobile than adult birds and gas exchange can occur through the skin (and respiratory membranes could possibly be damaged by chloropicrin), and thus amphibians may be at similar or greater risk overall. Chloropicrin is a type of tear gas that produces sublethal symptoms in mammals at levels much lower than lethal levels. The same may be true for amphibians, including the CRLF. If this were the case, frogs could potentially move from their preferred location or alter their feeding or breeding behavior, for example.

5.2.3 Indirect Effects to CRLF Based on Effects to Plants (food supply, habitat,

cover, primary productivity, riparian vegetation)

Based on the phytotoxicity of chloropicrin on the treated fields, non-target plants off-site may also be at risk from off-gassed chloropicrin and chloropicrin in runoff to water bodies. Aquatic and terrestrial plant toxicity data are not available to evaluate these potential risks. Aquatic plant data are used as a measure of ecological effects for indirect effects to the aquatic-phase CRLF via effects to the food supply, habitat, cover, and/or primary productivity; and effects to critical habitat. Terrestrial plant data are used as a measure of ecological effects for indirect effects to the aquatic-phase and terrestrial-phase CRLF via effects to riparian vegetation; and effects to critical habitat.

A published study (ECOTOX Ref No. 77614) reported that chloropicrin treatment of live trees appeared to impact the plant community around the treated trees. Ten growing seasons after application, total plant cover was significantly reduced. The authors considered the results of this study to be preliminary. In a study of treated stumps (ECOTOX Ref No. 89224), the study authors report "*T. latifolia* may be sensitive and act as an early indicator of chloropicrin effects in the clearcut habitat" but that "chloropicrin had little other effect on surrounding vegetation in the first three years following application"**.** In a further study of treated stumps (ECOTOX Ref No. 77685), study authors report that "five years after harvest and fumigation, no significant differences in vegetation composition or cover were found. Chloropicrin significantly increased diversity (Hill's measure) but not richness". These reports provide information regarding the effects of these very specialized uses of chloropicrin, but are not adequate for assessing the many pre-plant incorporated uses that comprise the majority of chloropicrin use.

5.2.4 Review of Incident Data

In making an effects determination for the CRLF, incident data provide an additional line of evidence to that provided by RQs. Limited terrestrial animal (non-human) incident data are available for chloropicrin. For example, there was an incident in Europe, in which a mis-labeled product that was later determined to contain chloropicrin was inadvertently used in a greenhouse in combination with metam sodium. It resulted in large numbers of domestic animal deaths when the chloropicrin gas escaped to the surrounding area (Selala, et. al. 1989). Although this incident does <u>not</u> reflect the expected exposure from labeled uses reviewed in the present risk assessment, it does indicate the potential for hazard if chloropicrin were to be mis-handled and get into the ground-level air at high concentrations.

In an aquatic animal incident involving chloropicrin and telone beginning 9/1/05, several thousand dead fish were reported over a 3-mile reach of Casserly Creek in Santa Cruz County, California. Mortality was observed near a strawberry field being fumigated (using chemigation) with the product Inline (R). Species killed included steelhead/rainbow trout, sculpin, hitch, and Sacramento blackfish. Crayfish were also killed (I-016955-001; 11/18/05 Pesticide Laboratory Report, California Department of Fish and Game). Inline (R) (Registration number 62719-348) is a 60.8 % telone/33.3 % chloropicrin product. A certainty level in the Ecological Incident Information System (EIIS) of "highly probable" for chloropicrin has been assigned to this incident, based on the 11/18/05 report. There is no mention of rain in the 11/18/05 report, the applicator has cited a possible defective valve in a flush line (I-016884), and the registrant has claimed that a valve was mistakenly opened (I-016738-016). Consequently, this incident has been categorized as "Misuse (accidental)". This incident shows the potential for substantial adverse effects to aquatic life if there are equipment failures, or mistakes occur in the application.

Three plant incidents involving fumigant products with chloropicrin as one of the active ingredients have been identified in a 1/19/06 report by M. Kathleen O'Malley (ITRMD/OPP). One of these involved the product Telone C-35 (62719-302; 63.4% telone, 34.7% chloropicrin) and was coded as major by ITRMD. The other two incidents were coded by ITRMD as minor: one involved this same combination product with telone; the other involved a combination product with methyl bromide (Tri-con 57/43 Preplant Soil Fumigant; 11220-4, 57% methyl bromide, 42.6% chloropicrin). The major incident (I 014702-076) is in EIIS, and involved 91 acres of watermelon. EIIS also lists an additional plant incident involving reported damage to an apple orchard in 1998 (I 007358-001). These incidents help confirm the assumption that chloropicrin has the potential to adversely affect non-target plants.

5.2.5 Probit Dose Response Relationship

An analysis has been conducted of the probability of individual mortality at an LOC of 0.1, the acute endangered species LOC for wild mammals. It is recognized that extrapolation of very low probability events is associated with considerable uncertainty in the resulting estimates. The analysis uses the EFED spreadsheet IECv1.1.xls, developed by EFED (USEPA, 2004).

For mammals, slope and confidence interval information for the slope were not reported in the Data Evaluation Record for MRID 45117902, an acute inhalation study. Risk quotients in the ecological risk assessment used the inhalation toxicity value for male rats, where there was only one partial mortality. Since probit results are not possible with only one partial mortality, a default slope of 4.5 and confidence interval of 2 to 9 are used for the individual mortality probability analysis. Based on an assumption of a probit dose response relationship with a mean estimated slope of 4.5, the corresponding estimated chance of individual mortality associated with the listed species LOC of 0.1, the acute toxic endpoint for wild mammals, is approximately one in 294,000. To explore possible bounds to such estimates, the upper and lower values for the mean slope estimate (2 - 9) were used to calculate upper and lower estimates of the effects probability associated with the listed species LOC. These values are approximately one in 44 and one in 10^{16} (default limit of Excel reporting).

As previously indicated, the acute risk quotient for mammals is estimated to be 0.17, based on ISCST3 modeling. This is slightly higher than the mammal acute endangered species LOC of 0.1. Thus, the probability of individual mortality at the predicted exposures used for the risk quotients would also be higher than at the LOC (and higher still if extrapolated to 1,076 lb ai/A). Based on PERFUM modeling, the acute RQ is estimated to be 0.037, below the LOC. Thus, the probability of individual mortality at the predicted exposures used for the risk quotients with this model would be lower than at the LOC. Extrapolating to 1, 076 lb ai/A resulted in an RQ slightly above the LOC even with the PERFUM model (0.11), and thus the probability of individual effects would also be slightly higher than at the LOC.

Data are not adequate to calculate individual effect probabilities for freshwater fish and aquatic invertebrates. This is due to a lack of measured concentrations in the fish studies and uncertainties in the measured concentrations in the daphnid study (in the lowest four concentrations at 48 hours). Data are not available to calculate individual effects for other taxonomic groups.

5.2.6 Effects Determination: Direct Effects to the California Red Legged Frog

Direct effects to the CRLF include direct effects to both aquatic and terrestrial phases of the CRLF. Aquatic phases of the CRLF, as described earlier, include eggs, larvae, tadpoles, juveniles, and adults. Terrestrial phases include juveniles and adults.

Based on the LOC exceedances for fish (surrogate for the frog), chloropicrin may directly effect aquatic phase CRLFs. Given the widespread overlap of potential chloropicrin use with watersheds of the CRLF, there is thus considered to be a “likely to adversely affect” for direct effects of chloropicrin to aquatic phases of the CRLF.

The assessment for direct effects the terrestrial phase CRLF is based on mammals as a surrogate for birds which are a surrogate for terrestrial-phase amphibians. Based on the exceedance of an “equivalent LOC” for acute inhalation, with one of two models (at an application rate well below the maximum on current labels), and with both models (when extrapolate to the maximum rate), chloropicrin “may effect” terrestrial phase CRLFs. Also, chloropicrin is a highly irritating material (tear gas) and could produce adverse reactions at levels well below levels expected to be lethal. If this were the case, frogs could potentially move from their preferred location or alter their feeding or breeding behavior, for example. Disturbance is considered a “take” under the ESA, and a substance as irritating as chloropicrin could potentially cause disturbance to the CRLF. Given the widespread overlap of potential chloropicrin use with upland and dispersal areas that terrestrial phases inhabit, as well as the potential for off-gassed chloropicrin to move into riparian areas where the terrestrial phase frogs are also located, chloropicrin is thus “likely to adversely affect” terrestrial phase CRLFs.

5.2.7 Effects Determination: Indirect Effects to the California Red Legged Frog

As described earlier, indirect effects to aquatic phases are possible with 1) effects to the food supply of the CRLF, 2) effects to aquatic habitat, cover, and/or primary productivity, and/or 3) effects to riparian vegetation. Indirect effects to terrestrial phases are possible with 1) effects on prey and/or 2) effects on habitat (i.e., riparian vegetation).

Based on the LOC exceedances for both fish and aquatic invertebrates, chloropicrin "may effect" indirectly aquatic phase CRLFs, based on food supply effects. Additionally, given that chloropicrin is intended to control many plants on the application sites, there may also be affects on aquatic plants used as food by the frogs (data are not adequate for RQ calculations).

Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts to CRLF aquatic habitat, cover, and/or primary productivity, as well as to riparian vegetation required by the aquatic-phase CRLF (data are not adequate for RQ calculations). A limited number of plant incidents also help confirm the potential for chloropicrin to adversely affect non-target plants.

Based on the LOC exceedances of an "equivalent LOC" for acute inhalation, with one of two models (at an application rate well below the maximum on current labels), and with both models (when extrapolate to the maximum rate), there is also considered to be the potential for indirect effects to CRLF terrestrial phases via possible effects on prey such as small mammals and terrestrial phase amphibians. Given that chloropicrin is intended to control many terrestrial invertebrates on the application sites, it may also have an indirect effect on the CRLF via an impact to terrestrial invertebrates used as prey by the CRLF. Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts to riparian vegetation used by terrestrial phases of the CRLF. Assumptions regarding potential impacts to both terrestrial invertebrates and plants off-site based on intended effects on-site include uncertainty regarding the potential for off-gassing to have adverse effects. Effects could also potentially result from runoff to adjacent land, as chloropicrin is highly water-soluble. A limited number of plant incidents also help confirm the potential for chloropicrin to adversely affect non-target plants.

5.2.8 Effects Determination: Effects to Designated Critical Habitat

As described earlier, there are two aquatic phase primary constituent elements (PCEs) for Critical Habitat: aquatic breeding habitat and aquatic non-breeding habitat. Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts to aquatic and terrestrial plants that comprise these PCEs. A limited number of plant incidents also help confirm the potential for chloropicrin to adversely affect non-target plants.

Based on the LOC exceedances for both fish and aquatic invertebrates, there may also be the potential for alteration of characteristics necessary for normal growth and viability of CRLFs and their food source.

There are two terrestrial phase PCEs for Critical Habitat: upland habitat and dispersal habitat. As above for the aquatic phase PCEs, given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts to terrestrial plants that comprise the terrestrial phase PCEs. A limited number of plant incidents also help confirm the potential for chloropicrin to adversely affect non-target plants. Based on the LOC exceedances for freshwater fish and the exceedances of "equivalent LOCs" for terrestrial organism inhalation, there is the potential for reduction and/or modification of food sources for terrestrial phase juveniles and adults or alteration of characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.

5.2.9 Baseline Status and Cumulative Effects

Attachment 2 provides a Baseline Status and Cumulative Effects for the CRLF. The information in this attachment was synthesized from information provided to EPA by the U.S. Fish and Wildlife Service.

6.0 Uncertainties

6.1 Environmental Fate and Exposure

The environmental fate data base for the parent compound provided mostly supplemental information. However, key environmental fate studies such as aerobic soil metabolism and photolysis in air have several deficiencies and problems. Therefore, data related to these key environmental fate processes were also obtained from open literature to complete the environmental fate and exposure assessment.

There are uncertainties in estimating chloropicrin exposure in surface water from post-application, due to tarping of the treated area. If tarping is used to minimize the volatilization of chloropicrin, the loading of the chemical through runoff will be limited until the tarp is sliced or removed from the field. The present version of the PRZM model and the selected crop scenarios used in modeling have limited capabilities in discounting the load from runoff of applied chemical under a post-application tarp scenario. Since the load of chloropicrin from runoff is considered in the PRZM/EXAMS simulation, the estimated concentrations of chloropicrin in surface water bodies may be upper bound. PRZM also has limited capabilities in capturing the partitions of a volatile chemical in air, water and sediment.

There are uncertainties with both existing monitoring and modeling of air residues for the purpose of estimating exposure to terrestrial wildlife. Since field emission and air monitoring data of chloropicrin were collected at various heights and 50 to 60 feet away from the treated fields, actual concentrations at ground level at the edge of the field may differ from estimated air concentration using ISCTS3 modeling and ambient air monitoring . Air monitoring at ground-level of chloropicrin in the fumigated fields may reduce the uncertainty related to terrestrial exposure for wildlife.

6.2 Ecological Effects

The following identified data gaps for ecological fate and effects endpoints result in a degree of uncertainty in evaluating the ecological risk of chloropicrin in the current assessment.

- No data are available to assess the acute or chronic effects of chloropicrin to birds.
- No data are available to assess the chronic effects of chloropicrin to freshwater fish.
- No data are available to assess the chronic effects of chloropicrin to freshwater invertebrates.
- No data are available to assess the effects of chloropicrin to terrestrial, aquatic, or semi-aquatic plants.

- The available mammal acute inhalation study has deficiencies and is considered non-guideline (The 7/25/00 DER and 1/31/05 Revised HED Human Health Risk Assessment state: “The LC50 calculated for the study should not be considered to be a true LC50 for chloropicrin. Due to the sacrifice of all live animals at day 3 of the study instead of day 14, and too large of exposure particle sizes, the true LC50 could be lower.”).

- Studies available on the effects of chloropicrin to freshwater fish and aquatic invertebrates are considered supplemental, with indeterminate toxicity values (i.e., “<“).

There are substantial uncertainties concerning the ecological effects of chloropicrin, in part due to the extremely limited data available for risk assessment. There are no studies considered fully acceptable for any taxonomic group or time exposure, except for the mammal acute oral and chronic inhalation data used.

The uncertainties associated with the direct risk to terrestrial-phase CRLF from chloropicrin use are mainly focused on the extent and effect of exposure via inhalation. There is uncertainty with the mammal acute inhalation toxicity (see above). Avian inhalation toxicity data are not available at all, as also noted. In addition, the lack of avian acute oral data prevents an extrapolated estimation of inhalation toxicity based on mammal data. Plant data are not available to assess risk to non-target terrestrial plants off-site.

Because of applications to different fields on different days in a given geographic area, there is the added potential for repeat exposure. Thus, in addition to the uncertainty of not having an avian acute inhalation study, there is some further uncertainty in not having a longer term avian study (e.g., over 4 hours).

The uncertainties associated with the direct risk to aquatic-phase CRLF and indirect effects via the aquatic food supply and habitat from chloropicrin are due to uncertainties over the length of exposure to this highly volatile chemical and to uncertainties over the toxicity (resulting mainly from the volatility). However, both acute and chronic exposure are possible, in part due to repeat or continuous input to the aquatic environment. Acute and chronic toxicity data are not available for most fish and aquatic invertebrate guideline test categories. The risk assessment relies on supplemental data for freshwater fish and aquatic invertebrates.

6.3 Maximum Use Scenario

The screening-level risk assessment focuses on characterizing potential ecological risks resulting from a maximum use scenario, which is determined from labeled statements of maximum application rate and number of applications with the shortest time interval between applications. The frequency at which actual uses approach this maximum use scenario may be dependant on insecticide resistance, timing of applications, cultural practices, and market forces.

6.4 Usage Uncertainties

County-level usage data were obtained from California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database. Four years of data (2002 – 2005) were included in this analysis because statistical methodology for identifying outliers, in terms of area treated and pounds applied, was provided by CDPR for these years only. No methodology for removing outliers was provided by CDPR for 2001 and earlier pesticide data; therefore, this information was not included in the analysis because it may misrepresent actual usage patterns. CDPR PUR documentation indicates that errors in the data may include the following: a misplaced decimal; incorrect measures, area treated, or units; and reports of diluted pesticide concentrations. In addition, it is possible that the data may contain reports for pesticide uses that have been cancelled. The CPDR PUR data does not include home owner applied pesticides; therefore, residential uses are not likely to be reported. As with all pesticide use data, there may be instances of misuse and misreporting. The Agency made use of the most current, verifiable information; in cases where there were discrepancies, the most conservative information was used.

6.5 Modeling Inputs

The standard ecological water body scenario (EXAMS pond) used to calculate potential aquatic exposure to pesticides is intended to represent conservative estimates, and to avoid underestimations of the actual exposure. The standard scenario consists of application to a 10-hectare field bordering a 1-hectare, 2-meter deep (20,000 m3) pond with no outlet. Exposure estimates generated using the EXAMS pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and lower order streams. As a group, there are factors that make these water bodies more or less vulnerable than the EXAMS pond. Static water bodies that have larger ratios of pesticide-treated drainage area to water body volume would be expected to have higher peak EECs than the EXAMS pond. These water bodies will be either smaller in size or have larger drainage areas. Smaller water bodies have limited storage capacity and thus may overflow and carry pesticide in the discharge, whereas the EXAMS pond has no discharge. As watershed size increases beyond 10-hectares, it becomes increasingly unlikely that the entire watershed is planted with a single crop that is all treated simultaneously with the pesticide. Headwater streams can also have peak concentrations higher than the EXAMS pond, but they likely persist for only short periods of time and are then carried and dissipated downstream.

The Agency acknowledges that there are some unique aquatic habitats that are not accurately captured by this modeling scenario and modeling results may, therefore, under- or over-estimate exposure, depending on a number of variables. For example, aquatic-phase CRLFs may inhabit water bodies of different size and depth and/or are located adjacent to larger or smaller drainage areas than the EXAMS pond. The Agency does not currently have sufficient information regarding the hydrology of these aquatic habitats to develop a specific alternate scenario for the CRLF. CRLFs prefer habitat with perennial (present year-round) or near-perennial water and do not frequently inhabit vernal (temporary) pools because conditions in these habitats are generally not suitable (Hayes and Jennings 1988). Therefore, the EXAMS pond is assumed to be representative of exposure to aquatic-phase CRLFs. In addition, the Services agree that the existing EXAMS pond represents the best currently available approach for estimating aquatic exposure to pesticides (USFWS/NMFS 2004).

6.7 Action Area

An example of an important simplifying assumption that may require future refinement is the assumption of uniform runoff characteristics throughout a landscape. It is well documented that runoff characteristics are highly non-uniform and anisotropic, and become increasingly so as the area under consideration becomes larger. The assumption made for estimating the aquatic Action Area (based on predicted in-stream dilution) was that the entire landscape exhibited runoff properties identical to those commonly found in agricultural lands in this region. However, considering the vastly different runoff characteristics of: a) undeveloped (especially forested) areas, which exhibit the least amount of surface runoff but the greatest amount of groundwater recharge; b) suburban/residential areas, which are dominated by the relationship between impermeable surfaces (roads, lots) and grassed/other areas (lawns) plus local drainage management; c) urban areas, that are dominated by managed storm drainage and impermeable surfaces; and d) agricultural areas dominated by Hortonian and focused runoff (especially with row crops), a refined assessment should incorporate these differences for modeled stream flow generation. As the zone around the immediate (application) target area expands, there will be greater variability in the landscape; in the context of a risk assessment, the runoff potential that is assumed for the expanding area will be a crucial variable (since dilution at the outflow point is determined by the size of the expanding area). Thus, it important to know at least some approximate estimate of types of land use within that region. Runoff from forested areas ranges from 45 – 2,700% less than from agricultural areas; in most studies, runoff was 2.5 to 7 times higher in agricultural areas (e.g., Okisaka et al., 1997; Karvonen et al., 1999; McDonald et al., 2002; Phuong and van Dam 2002). Differences in runoff potential between urban/suburban areas and agricultural areas are generally less than between agricultural and forested areas. In terms of likely runoff potential (other variables – such as topography and rainfall – being equal), the relationship is generally as follows (going from lowest to highest runoff potential):
Three-tiered forest < agroforestry < suburban < row-crop agriculture < urban.

There are, however, other uncertainties that should serve to counteract the effects of the aforementioned issue. For example, the dilution model considers that 100% of the agricultural area has the chemical applied, which is almost certainly a gross over-estimation. Thus, there will be assumed chemical contributions from agricultural areas that will actually be contributing only runoff water (dilutant); so some contributions to total contaminant load will really serve to lessen rather than increase aquatic concentrations. In light of these (and other) confounding factors, Agency believes that this model gives us the best available estimates under current circumstances.

6.8 Aquatic Exposure Estimates

In general, the linked PRZM/EXAMS model produces estimated aquatic concentrations that are expected to be exceeded once within a ten-year period. The Pesticide Root Zone Model is a process or "simulation" model that calculates what happens to a pesticide in a farmer's field on a day-to-day basis. It considers factors such as rainfall and plant transpiration of water, as well as how and when the pesticide is applied. It has two major components: hydrology and chemical transport. Water movement is simulated by the use of generalized soil parameters, including field capacity, wilting point, and saturation water content. The chemical transport component can simulate pesticide application on the soil or on the plant foliage. Dissolved, adsorbed, and vapor-phase concentrations in the soil are estimated by simultaneously considering the processes of pesticide uptake by plants, surface runoff, erosion, decay, volatilization, foliar wash-off, advection, dispersion, and retardation.

Uncertainties associated with each of these individual components add to the overall uncertainty of the modeled concentrations. Additionally, model inputs from the environmental fate degradation studies are chosen to represent the upper confidence bound on the mean values that are not expected to be exceeded in the environment approximately 90 percent of the time. Mobility input values are chosen to be representative of conditions in the environment. The natural variation in soils adds to the uncertainty of modeled values. Factors such as application date, crop emergence date, and canopy cover can also affect estimated concentrations, adding to the uncertainty of modeled values. Factors within the ambient environment such as soil temperatures, sunlight intensity, antecedent soil moisture, and surface water temperatures can cause actual aquatic concentrations to differ for the modeled values.

Unlike spray drift, tools are currently not available to evaluate the effectiveness of a vegetative setback on runoff and loadings. The effectiveness of vegetative setbacks is highly dependent on the condition of the vegetative strip. For example, a well-established, healthy vegetative setback can be a very effective means of reducing runoff and erosion from agricultural fields. Alternatively, a setback of poor vegetative quality or a setback that is channelized can be ineffective at reducing loadings. Until such time as a quantitative method to estimate the effect of vegetative setbacks on various conditions on pesticide loadings becomes available, the aquatic exposure predictions are likely to overestimate exposure where healthy vegetative setbacks exist and underestimate exposure where poorly developed, channelized, or bare setbacks exist.

6.9 Age Class and Sensitivity of Effects Thresholds

It is generally recognized that test organism age may have a significant impact on the observed sensitivity to a toxicant. The acute toxicity data for fish are collected on juvenile fish between 0.1 and 5 grams. Aquatic invertebrate acute testing is performed on recommended immature age classes (e.g., first instar for daphnids, second instar for amphipods, stoneflies, mayflies, and third instar for midges).

Testing of juveniles may overestimate toxicity at older age classes for pesticide active ingredients that act directly without metabolic transformation because younger age classes may not have the enzymatic systems associated with detoxifying xenobiotics. In so far as the available toxicity data may provide ranges of sensitivity information with respect to age class, this assessment uses the most sensitive life-stage information as measures of effect for surrogate aquatic animals, and is therefore, considered as protective of the California Red Legged Frog.

6.10 Sublethal Effects

For an acute risk assessment, the screening risk assessment relies on the acute mortality endpoint as well as a suite of sublethal responses to the pesticide, as determined by the testing of species response to chronic exposure conditions and subsequent chronic risk assessment. Consideration of additional sublethal data in the assessment is exercised on a case-by-case basis and only after careful consideration of the nature of the sublethal effect measured and the extent and quality of available data to support establishing a plausible relationship between the measure of effect (sublethal endpoint) and the assessment endpoints.

6.11 Location of Wildlife Species

For this baseline terrestrial risk assessment, a generic bird or mammal was assumed to occupy either the treated field or adjacent areas receiving a treatment rate on the field. Actual habitat requirements of any particular terrestrial species were not considered, and it was assumed that species occupy, exclusively and permanently, the modeled treatment area. Spray drift model predictions suggest that this assumption leads to an overestimation of exposure to species that do not occupy the treated field exclusively and permanently.

7.0 Summary of Direct and Indirect Effects to the CRLF and Adverse Modification to Designated Critical Habitat

Table 7.1 Effects Determination Summary for Direct and Indirect Effects of Chloropicrin on the California Red-legged Frog

Assessment Endpoint	Effects Determination	Basis
Aquatic-Phase (Eggs, Larvae, Tadpoles, Adults)		
1. Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	Likely to Adversely Affect	Chloropicrin acute RQs exceed LOC for direct effects using acute fish data. Chronic data are not available. There is widespread overlap of potential chloropicrin use with watersheds of the CRLF.
2. Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.,* freshwater fish and invertebrates, non-vascular plants)	Likely to Adversely Affect	Chloropicrin acute RQs exceed LOCs for freshwater fish and aquatic invertebrates. Chronic data are not available. There is widespread overlap of potential chloropicrin use with watersheds of the CRLF.
3. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, and/or primary productivity (*i.e.,* aquatic plant community)	Likely to Adversely Affect[1]	Although data adequate for RQs are not available, chloropicrin is a broad spectrum toxicant intended to kill many plants on-site. Modeling shows the potential for aquatic exposure and therefore aquatic non-target plants may be at risk.
4. Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	Likely to Adversely Affect[1]	Although data adequate for RQs are not available, chloropicrin is a broad spectrum toxicant intended to kill many plants on-site. Modeling shows the potential for for both aquatic exposure (e.g., from runoff) and terrestrial exposure from off-gassing and therefore riparian non-target plants may be at risk.
Terrestrial Phase (Juveniles and adults)		
5. Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	Likely to Adversely Affect	Choropicrin exceeds an equivalent LOC for acute inhalation (resulting from off-gassing), based on available mammal data. There is potential for widespread chloropicrin use in the vicinity of upland and dispersal areas of the CRLF.

Table 7.1 Effects Determination Summary for Direct and Indirect Effects of Chloropicrin on the California Red-legged Frog

Assessment Endpoint	Effects Determination	Basis
6. Survival, growth, and reproduction of CRLF individuals via effects on prey (*i.e.,* terrestrial invertebrates, small terrestrial vertebrates, including mammals and terrestrial phase amphibians)	Likely to Adversely Affect	Choropicrin exceeds an equivalent LOC for small vertebrate prey for acute inhalation (resulting from off-gassing), based on available mammal data. Given that chloropicrin is intended to control many terrestrial invertebrates on the application sites, it may also have an indirect effect on the CRLF via an impact to terrestrial invertebrates used as prey by the CRLF. There is potential for widespread chloropicrin use in the vicinity of upland and dispersal areas of the CRLF.
7. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.,* riparian vegetation)	Likely to Adversely Affect[1]	Although data adequate for RQs are not available, chloropicrin is a broad spectrum toxicant intended to kill many plants on-site. Modeling shows the potential for for terrestrial exposure from off-gassing and therefore non-target plants (including riparian vegetation) may be at risk.

[1] Relies on assumptions regarding effects to non-target plants, and a limited number of plant incidents (see Basis and Section 5.2)

Table 7.2 Effects Determination Summary for the Critical Habitat Impact Analysis

Assessment Endpoint	Effects Determination	Basis
Aquatic Phase PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)		
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	Habitat Modification[1]	Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts to aquatic and terrestrial plants that comprise these habitats.
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source[2].	Habitat Modification[1]	Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts to aquatic and terrestrial plants that comprise these habitats.
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	Habitat Modification	Fish and aquatic invertebrate acute RQs exceed LOCs.

Table 7.2 Effects Determination Summary for the Critical Habitat Impact Analysis

Assessment Endpoint	Effects Determination	Basis
Aquatic Phase PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)		
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.,* algae)	Habitat Modification[1]	Given that chloropicrin is intended to control many plants on the application sites, and modeling shows the potential for chloropicrin to get to water bodies, there may also be the potential for impacts to aquatic plants that comprise these habitats.
Terrestrial Phase PCEs (Upland Habitat and Dispersal Habitat)		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	Habitat Modification[1]	Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts (from off-gassed chloropicrin) to terrestrial plants that comprise these habitats.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	Habitat Modification[1]	Given that chloropicrin is intended to control many plants on the application sites, there may also be the potential for impacts (from off-gassed chloropicrin) to terrestrial plants that comprise these habitats.
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	Habitat Modification	Chloropicrin poses acute risk to prey items of the CRLF, including freshwater fish and invertebrates, small mammals, and likely terrestrial invertebrates, for example.
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	Habitat Modification	Chloropicrin poses acute risk to prey items of the CRLF, including freshwater fish and invertebrates, small mammals, and likely terrestrial invertebrates, for example.

[1] Relies on assumptions regarding effects to non-target plants, and a limited number of plant incidents (see Basis and Section 5.2)

[2] Physico-chemical water quality parameters such as salinity, pH, and hardness are not evaluated because these processes are not biologically mediated and, therefore, are not relevant to the endpoints included in this assessment.

When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (i.e., food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (i.e., attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available. Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of CRLF life stages within specific recovery units and/or designated critical habitat within the action area. This information would allow for quantitative extrapolation of the present risk assessment's predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the species.
- Quantitative information on prey base requirements for individual aquatic- and terrestrial-phase frogs. While existing information provides a preliminary picture of the types of food sources utilized by the frog, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.
- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual frogs and potential adverse modification to critical habitat.

8.0 References

Alvarez, J. 2000. Letter to the U.S. Fish and Wildlife Service providing comments on the Draft California Red-legged Frog Recovery Plan.

Altig, R. and R.W. McDiarmid. 1999. Body Plan: Development and Morphology. In R.W. McDiarmid and R. Altig (Eds.), Tadpoles: The Biology of Anuran Larvae.University of Chicago Press, Chicago. pp. 24-51.

Barry TA; Segawa R; Wofford P; Ganapathy C. 1997. Off-site air monitoring following methyl bromide chamber and warehouse fumigations and evaluation of the Industrial Source Complex-Short Term 3 Air Dispersion Model. Chapter 14 in Fumigants: Environmental Fate, Exposure and Analysis, ACS Symposium Series 652. Editors JN Seiber et al. American Chemical Society: Washington D.C., pp. 178 - 88.

Burns, L.A. 2002. Exposure Analysis Modeling System (EXAMS): User Manual and system documentation. National Exposure Research Laboratory. U.S. Environmental Protection Agency, Research Trianglr Park, NC 27711.
http://www.epa.gov/ceampubl/swater/exams/index.htm

Carsel, RF; Imhoff, JC; Hummel, PR; Cheplick, JM; and Donigian, AS Jr. 1998. PRZM-3, A Model for Predicting Pesticide and Nitrogen Fate in the Crop Root and Unsaturated Soil Zones: Users Manual for Release 3.0. National Exposure Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, GA.
http://www.epa.gov/ceampubl/gwater/przm3/index.htm

Carter, W.P.L., D. Luo, and I.L. Malkina. 1997. Investigation of the Atmospheric Reactions of Chloropicrin. Atmospheric Environment. 31:1425-1439.

CARB (California Air Resources Board).2005. Report for Air Monitoring Around a Bed Fumigation for Chloropicrin in Santa Cruz County, 2003. California Environmental Protection Agency Air Resources Board, Sacramento, Ca.
http://www.cdpr.ca.gov/docs/empm/pubs/tac/studies/chlrpicrin.htm

CARB (California Air Resources Board). 2004. Ambient Air Monitoring for Chloropicrin and Breakdown Products of Metam Sodium in Monterey and Santa Cruz Counties , Fall 2001. California Environmental Protection Agency Air Resources Board, Sacramento, Ca. *http://www.cdpr.ca.gov/docs/empm/pubs/tac/studies/chlrpicrin.htm*

CARB (California Air Resources Board). 2003a. Ambient Air Monitoring for Chloropicrin and Breakdown Products of Metam Sodium in Kern County , Summer 2001. California Environmental Protection Agency Air Resources Board, Sacramento, Ca. *http://www.cdpr.ca.gov/docs/empm/pubs/tac/studies/chlrpicrin.htm*

CDC (Center for Disease Control). 2004. Brief Report: Illness Associated with Drift of Chloropicrin Soil Fumigant into a Residential Area -- Kern County, California, 2003. Morbidity and Mortality Weekly Report. Aug. 20, 2004. 53:740-742. *http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5332a4.htm*
CDPR (California Department of Pesticide Regulation. 2003. Semiannual report summarizing the reevaluation status of pesticide products during the period of January 1, 2003 through June 30, 2003. CEPA Dept. Of Pesticide Registration, Sacramento, *http://www.cdpr.ca.gov/docs/canot/ca03-4.htm*

CEPA (California Air Resources Board). 2003b. Report for Air Monitoring Around a Bed Fumigation of Chloropicrin Fall 2001. California Environmental Protection Agency Air Resources Board, Sacramento, Ca. *http://www.cdpr.ca.gov/docs/empm/pubs/tac/studies/chlrpicrin.htm*

Chickos J.S. and W. E. Acree. 2003. Enthalpies of vaporization of organic and organometallic compounds. 1880-2002. J Phys Chem Ref Data 32: 519-853.

Crawshaw, G.J. 2000. Diseases and Pathology of Amphibians and Reptiles *in:* Ecotoxicology of Amphibians and Reptiles; ed: Sparling, D.W., G. Linder, and C.A. Bishop. SETAC Publication Series, Columbia, MO.

Ecotoxnet. 2001. Chloropicrin. *http:/pmep.cce.cornell.edu/profiles/extoxnet/carbaryl-dicrotophos/chloropicrin.*

Fellers, G. M., et al. 2001. Overwintering tadpoles in the California red-legged frog (*Rana aurora draytonii*). Herpetological Review, 32(3): 156-157.

Fellers, G.M, L.L. McConnell, D. Pratt, S. Datta. 2004. Pesticides in Mountain Yellow-Legged Frogs (Rana Mucosa) from the Sierra Nevada Mountains of California, USA. Environmental Toxicology & Chemistry 23 (9):2170-2177.

Fellers, Gary M. 2005a. *Rana draytonii* Baird and Girard 1852. California Red-legged Frog. Pages 552-554. *In*: M. Lannoo (ed.) Amphibian Declines: The Conservation Status of United States Species, Vol. 2: Species Accounts. University of California Press, Berkeley, California. xxi+1094 pp. (http://www.werc.usgs.gov/pt-reyes/pdfs/Rana%20draytonii.PDF)

Fellers, Gary M. 2005b. California red-legged frog, *Rana draytonii* Baird and Girard. Pages 198-201. *In*: L.L.C. Jones, et al (eds.) Amphibians of the Pacific Northwest. xxi+227.

Fuller, E. N., P. D. Schettler and J.C. Giddings. 1966. A new method for prediction of binary gas-phase diffusion coefficients. Ind Eng Chem 58: 19-27.

Gan, J., S.R. Yates, F.F. Ernst, and W.A. Jury. 2000. Degradation and volatilization of

the fumigant chloropicrin after soil treatment. J. Environ. Qual. 29:1991-1397.
Grosjean, D. 1991. Atmospheric chemistry of toxic contaminants. Four saturated halogenated aliphatics:methyl bromide, epichlorohydrin, phosgene. J Air Waste 1:56-61.

Hayes, M.P. and M.R. Jennings. 1988. Habitat correlates of distribution of the California red-legged frog (*Rana aurora draytonii*) and the foothill yellow-legged frog (*Rana boylii*): Implications for management. Pp. 144-158. In Proceedings of the symposium on the management of amphibians, reptiles, and small mammals in North America. R. Sarzo, K.E. Severson, and D.R. Patton, (technical coordinators). USDA Forest Service General Technical Report RM-166.

Hayes, M.P. and M.M. Miyamoto. 1984. Biochemical, behavioral and body size differences between *Rana aurora aurora* and *R. a. draytonii*. Copeia 1984(4): 1018-22.

Hayes and Tennant. 1985. Diet and feeding behavior of the California red-legged frog. The Southwestern Naturalist 30(4): 601-605.

Helas, G. And S. Wilson, 1992. On sources and sinks of phosgene in the troposphere. Atmos. Envir. 26A:2975-2982

Jennings, M.R. and M.P. Hayes. 1985. Pre-1900 overharvest of California red-legged frogs (*Rana aurora draytonii*): The inducement for bullfrog (*Rana catesbeiana*) introduction. Herpetological Review 31(1): 94-103.

Jennings, M.R. and M.P. Hayes. 1994. Amphibian and reptile species of special concern in California. Report prepared for the California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California. 255 pp.

Jennings, Mark R. 1988. Natural history and decline of native ranids in California. Pp. 61-72. *In* Proceedings of the conference on California herpetology. H.F. DeLisle, P.R. Brown, B. Kaufman, and H.M. McGurty (eds). Southwestern Herpetologists Society Special Publication (4): 1-143.

Jennings, M.R., S. Townsend, and R.R. Duke. 1997. Santa Clara Valley Water District California red-legged frog distribution and status – 1997. Final Report prepared by H.T. Harvey & Associates, Alviso, California. 22 pp.

Karvonen, T., Koivusalo, H., Jauhiainen, M., Palko, J. and Weppling, K. 1999. A hydrological model for predicting runoff from different land use areas, Journal of Hydrology, 217(3-4): 253-265.

Kawamoto, K. and K. Uraro. 1989. Parameters for predicting fate of organochlorine pesticides in the environment (II) Adsorption constant to soil. Chemosphere 19: 1223-1231.

Kollman, W.S. 1990. Literature review of the Environmental Fate of Chloropicrin. Memorandum to R.S. Segawa, Environmental Hazards Assessment Program , California Dept. Of Food and Agriculture. 9 pp.

Kupferberg, S. 1997. Facilitation of periphyton production by tadpole grazing: Functional differences between species. Freshwater Biology 37:427-439.

Kupferberg, S.J., J.C. Marks and M.E. Power. 1994. Effects of variation in natural algal and detrital diets on larval anuran (*Hyla regilla*) life-history traits. Copeia 1994:446-457.

Lee, S., R. McLaughlin, M. Hardly, R. Gunier, and Richard Kreutzer. 2002. Community Exposures to Airborne Agricultural Pesticides in California: Ranking of Inhalation Risks. Environmental Health Perspectives. 110:1175 - 1184.

LeNoir, J.S., L.L. McConnell, G.M. Fellers, T.M. Cahill, J.N. Seiber. 1999. Summertime Transport of Current-use pesticides from California's Central Valley to the Sierra Nevada Mountain Range,USA. Environmental Toxicology & Chemistry 18(12): 2715-2722.

Luoma, D. L. and Thies, W. G. (1995). Effects of Live Free Tree Fumigation on Nontarget Vegetation. *Can.J.For.Res.* 24: 2384-2389. EcoReference No.: 77614

Luoma, D. L. and Thies, W. G. (1997). Stumps Fumigated with Chloropicrin: Effects on Surrounding Plants. *Can.J.For.Res.* 27: 1737-1745. EcoReference No.: 89224

Maddy, K.T., D. Gibbons, D.M. Richmond, and A.S. Fredrickson. 1983. A study of the levels of methyl bromide and chloropicrin in the air downwind from a field during and after a preplant fumigation (shallow injection) - a preliminary report. CDFA, Division of Pest Management, Environmental Protection and Worker Safety, Worker Health and Safety Unit. Report No. HS-1061

Maddy, K.T., D. Gibbons, D.M. Richmond, and A.S. Fredrickson. 1984. Additional monitoring of the concentrations of methyl bromide and chloropicrin in the air downwind from a field during and after a preplant fumigation (shallow injection) - a preliminary report. CDFA, Division of Pest Management, Environmental Protection and Worker Safety, Worker Health and Safety Unit. Report No. HS-1183

Manoque, W. And R. Pigford. 1960. The kinetics of the absorption of phosgene into water and aqueous solutions. A.I. Ch. E, Journal 6:494-500.

McConnell, L.L., J.S. LeNoir, S. Datta, J.N. Seiber. 1998. Wet deposition of current-use pesticides in the Sierra Nevada mountain range, California, USA. Environmental Toxicology & Chemistry 17(10):1908-1916.

McDonald M.A.1; Healey J.R.; Stevens P.A. 2002. The effects of secondary forest clearance and subsequent land-use on erosion losses and soil properties in the Blue Mountains of Jamaica. Agriculture, Ecosystems & Environment, Volume 92, Number 1: 1-19.

Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Budavari, S (ed.). Rahway, NJ; Merck and Co., Inc., 1989. 333.

MRID# 05007865. Moilanen, K.W., D.G. Crosby, J.R. Humphrey, and J.W. Giles. 1978. Vapor phase photodecomposition of chloropicrin (trichloronitromethane). Tetrahedron. 34:3345-3349.

MRID# 42900201. Moreno, T., and H. Lee. 1993. Photodegradation of chloropicrin. Laboratory Project ID: BR 389.1:93. Unpublished study performed by Bolsa Research Associates, Inc., Hollister, CA, and submitted by Chloropicrin Manufacturers Task Force.

MRID# 43022401. Chang, T. 1989. Hydrolysis study with chloropicrin as a function of pH at 25□C. Laboratory Project ID.: B.R. 51:89. Unpublished study performed by Bolsa Research Associates, Hollister, CA, and submitted by The Chloropicrin Industry Panel, West Lafayette, IN

MRID# 43085101. Ivancovich, A. 1987. Chloropicrin - Field dissipation study. Laboratory Project ID: BR11:87.1. Unpublished study performed by Bolsa Research Associates, Hollister, CA, and submitted by the Chloropicrin Industry Panel.

MRID# 43613901 Hatton C., K. Shepler, and L. Ruzo. 1995. Aerobic soil metabolism of [^{14}C]chloropicrin. PTRL Report No.: 448W-1. PTRL Project No.: 448W. Unpublished study performed by PTRL West Inc., Richmond, CA; and submitted by Chloropicrin Manufacturers Task Force, c/o Niklor Chemical company, Long Beach, CA.

MRID# 43759301. Hatton, C., K. Shepler, and L. Ruzo. 1995. Anaerobic aquatic metabolism of [^{14}C]chloropicrin. PTRL Report No.: 449W-1. PTRL Project No.: 449W. Unpublished study performed by PTRL West, Inc., Richmond, CA; and submitted by Chloropicrin Manufacturers Task Force, c/o Niklor Chemical Company, Long Beach, CA.

MRID# 43798601. Skinner, W., and N. Jao. 1995. Laboratory volatility of [^{14}C]chloropicrin. PTRL Report No.: 450W-1. PTRL Project No.: 450W. Unpublished study performed by PTRL West, Inc., Richmond, CA; and submitted by The Chloropicrin Manufacturers Task Force, c/o Niklor Chemical Company, Long Beach, CA.

MRID# 44191301. Skinner, W. 1996. Soil column leaching of [^{14}C]chloropicrin in four soil types. PTRL Report No.: 587W-1. PTRL Project No.: 587W. Unpublished study performed by PTRL West, Inc. Richmond, CA; and submitted by The Chloropicrin

Manufacturers Task Force, c/o Niklor Chemical Company, Long Beach, CA.

NASS (National Agricultural Statistics Service) 2005. Year 2002 Usage statistics for chloropicrin http://www.pestmanagement.info/nass/

Okisaka S.; Murakami A.; Mizukawa A.; Ito J.; Vakulenko S.A.; Molotkov I.A.; Corbett C.W.; Wahl M.; Porter D.E.; Edwards D.; Moise C. 1997. Nonpoint source runoff modeling: A comparison of a forested watershed and an urban watershed on the South Carolina coast. Journal of Experimental Marine Biology and Ecology, Volume 213, Number 1: 133-149.

Pe4 Shell. 2004. Environmental Fate and Effects Division, Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. Information downloaded from the website http://www.epa.gov/oppefed1/models/water/

Phuong V.T. and van Dam J. Linkages between forests and water: A review of research evidence in Vietnam. ***In***: Forests, Water and Livelihoods European Tropical Forest Research Network. ETFRN NEWS (3pp).

Rathburn, G.B. 1998. *Rana aurora draytonii* egg predation. Herpetological Review, 29(3): 165.

Reis, D.K. Habitat characteristics of California red-legged frogs (*Rana aurora draytonii*): Ecological differences between eggs, tadpoles, and adults in a coastal brackish and freshwater system. M.S. Thesis. San Jose State University. 58 pp.

Sadtler Research Laboratories.1980. Standard Spectra Collection. Sadtler Research Laboratories Division of Bio-Rad Laboratories, Inc. Philadelphia, Pa.

Scheer, V., A. Frenzel, W. Behnke, C. Zetzsch, L. Magi, Ch. George, and Ph. Mirabel. 1997.Uptake of Nitrosyl Chloride (NOCL) by Aqueous Solutions. J. Phys. Chem. 101:9359 - 9366.

Seale, D.B. and N. Beckvar. 1980. The comparative ability of anuran larvae (genera: *Hyla*, *Bufo* and *Rana*) to ingest suspended blue-green algae. Copeia 1980:495-503.

Selala, M., et. al. 1989. An improperly labeled container with chloropicrin: A farmer's nightmare. Bull. Environ. Contam. Toxicol. 42: 202-208.

Singh H.B. 1976. Phosgene in the ambient air. Nature. 264:428-429.

Shorter, J.H., C.E. Kolb, and P.M. Crill. 1995. Rapid Degradation of Atmospheric Methylbromide in Soils. Nature. 377:717-719.

Sparling, D. W., G.M. Fellers, L.L. McConnell. 2001. Pesticides and amphibian population declines in California, USA. Environmental Toxicology & Chemistry 20(7): 1591-1595.

UNIDO. 2003. Ozone-friendly Industrial Development UNIDO in the Montreal Protocol - technology transfer to other countries. Impact and lessons learned - Fumigants. United Nations Industrial Development Organization, Vienna, Austria. 21 pp.

U.S. EPA (United States Environmental Protection Agency).1992. Pesticide in ground water data base. A compilation of monitoring studies: 1971-1991. A National summary. p. NS-163 (1992)

U.S. EPA (United States Environmental Protection Agency). 1995. User's Guide for the Industrial Source Complex Dispersion Models. Volume 1. User Instructions. USEPA Office of Air Quality Planning and Standards; Emissions, Monitoring and Analysis Division, Research Triangle Park, North Carolina.

USEPA. 1998. Guidelines for Ecological Risk Assessment. Published on May 14, 1998, Federal Register 63(93):26846-26924. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. EPA/630/R-95/002F. 191 pgs. April.

USEPA (U.S. Environmental Protection Agency). 2002. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000. U.S. Environmental Protection Agency, Office of Atmospheric Programs, EPA 430-R-02_003.

U.S. EPA. 2004. Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs. Office of Prevention, Pesticides, and Toxic Substances. Office of Pesticide Programs. Washington, D.C. January 23, 2004.

U.S. EPA (United States Environmental Protection Agency). 2004. Health Effects Division's Draft Standard Operating Procedures (SOPs) for Estimating Bystander Risk from Inhalation Exposure to Soil Fumigant.

USEPA (U.S. Environmental Protection Agency). 2005a. Overview of the Use and Usage of Soil Fumigants. Biological and Economic Analysis Division. U.S. Environmental Protection Agency, Office of Pesticide Programs. www.epa.gov/oppsrrd1/reregistration/soil_fumigants/soil_fumigant_use.pdf

USEPA (U.S. Environmental Protection Agency). 2005b. Environmental Fate and Ecological Risk Assessment for the Re-registration of Methyl Bromide. U.S. Environmental Protection Agency Office of Pesticide Programs, Washington, D.C.

USEPA (U.S. Environmental Protection Agency). 2005c. Human Health Risk Assessment: Chloropicrin. U.S. Environmental Protection Agency, Office of Pesticide Programs, Draft report.

U.S. Fish and Wildlife Service (USFWS). 1996. Endangered and threatened wildlife and plants: determination of threatened status for the California red-legged frog. Federal Register 61(101):25813-25833.

USFWS. 2002. Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii*). Region 1, USFWS, Portland, Oregon. (http://ecos.fws.gov/doc/recovery_plans/2002/020528.pdf)

USFWS. 2006. Endangered and threatened wildlife and plants: determination of critical habitat for the California red-legged frog. 71 FR 19244-19346.

USFWS. Website accessed: 30 December 2006. http://www.fws.gov/endangered/features/rl_frog/rlfrog.html#where

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 1998. Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act. Final Draft. March 1998.

USFWS/NMFS. 2004. 50 CFR Part 402. Joint Counterpart Endangered Species Act Section 7 Consultation Regulations; Final Rule. FR 47732-47762.

USFWS/NMFS. 2004. Letter from USFWS/NMFS to U.S. EPA Office of Prevention, Pesticides, and Toxic Substances. January 26, 2004. (http://www.fws.gov/endangered/consultations/pesticides/evaluation.pdf)

USFWS/NMFS 2004. Memorandum to Office of Prevention, Pesticides, and Toxic Substances, U.S. EPA conveying an evaluation by the U.S. Fish and Wildlife Service and National Marine Fisheries Service of an approach to assessing the ecological risks of pesticide products.

U.S. Forest Service. 1995. Prepared by Information Venture, Inc. under U.S. Forest Service Contract. http://www.infoventures.com/e-hlth/

Wassersug, R. 1984. Why tadpoles love fast food. Natural History 4/84.

Wilhelm, S.N., K. Shepler, L.J. Lawrence, and H. Lee. 1996. Environmental fate of Chloropicrin. P 79-83. In J.N Seiber et al. (ed.) Fumigants: Environmental fate, exposure, and analysis. ACS Symp. Ser. 652. American Chemical Society, Washington, DC.

Wilson, M. V., Ingersoll, C. A., and Thies, W. G. (1999). Testing for Effects of Stump Fumigation with Chloropicrin on Vegetation in an Early Seral Douglas-Fir Stand.

Can.J.For.Res. 29: 1254-1258. EcoReference No.: 77685

Woodrow, J.E., D.G. Crosby, and J.N. Seiber. 1983. Vapor-phase photochemistry of pesticides. Res. Rev. 85:111-125.

World Health Organization (WHO). 1998. Phosgene Health and Safety Guide. IPCS International Programme on Chemical Safety Health and Safety Guide No. 106. World Health Organization, Geneva, Switzerland. 16 pp.

World Meteorological Association.(WMO). 2002.WMO/UNEP Scientific Assessment of Ozone Depletion Report Number 47.

Yvon, S.A.. and J.H. Butler. 1996. An Improved Estimate of the Oceanic Lifetime of Atmospheric CH3Br. Geophysical Res. Lett. 23:53-56.

Appendices

Appendix A. PRZM/EXAMS model Inputs and Outputs

stored as CAStraw.out
Chemical: Chloropicrin
PRZM environment: CAS modified Monday, 16 April 2007 at 08:56:56
EXAMS environment: po modified Thuday, 29 August 2002 at 16:33:30
Metfile: w23234.dvf modified Wedday, 3 July 2002 at 10:04:22
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.00	0.00	0.00	0.00	0.00	0.00
1962	7.14	6.17	2.79	0.98	0.65	0.24
1963	2.60	2.01	1.01	0.54	0.37	0.09
1964	41.43	34.13	13.91	4.87	3.25	0.92
1965	30.15	26.06	9.30	3.74	2.49	1.02
1966	21.87	18.54	9.95	4.01	2.68	0.66
1967	5.00	4.01	1.85	0.73	0.49	0.21
1968	33.08	25.36	7.27	2.55	1.70	0.56
1969	61.57	47.33	19.76	6.92	4.61	1.61
1970	22.90	17.75	8.42	3.20	2.14	1.01
1971	19.73	15.39	5.20	1.82	1.21	0.52
1972	9.03	7.25	3.08	1.17	0.78	0.37
1973	41.44	32.84	13.18	4.61	3.08	1.07
1974	25.05	19.80	10.33	3.94	2.64	0.70
1975	2.35	1.85	0.85	0.43	0.30	0.07
1976	21.82	9.88	1.88	0.66	0.44	0.11
1977	30.70	24.80	12.52	4.85	3.24	1.39
1978	23.30	19.12	12.26	5.15	3.45	0.85
1979	74.67	59.47	19.95	6.98	4.65	1.46
1980	28.86	22.76	14.03	5.72	3.83	0.94
1981	45.08	34.64	13.88	4.86	3.24	0.91
1982	99.26	77.11	28.97	10.14	6.76	2.99
1983	76.31	63.60	19.12	6.69	4.46	1.81
1984	27.17	21.40	9.61	3.62	2.42	0.60
1985	0.58	0.44	0.18	0.07	0.05	0.01
1986	18.26	14.63	6.05	2.12	1.41	0.59
1987	15.85	12.41	5.71	2.22	1.48	0.37
1988	40.93	31.82	12.61	4.41	2.94	0.96
1989	14.20	11.24	5.41	2.06	1.38	0.34
1990	1.68	1.34	0.61	0.29	0.19	0.07

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	99.26	77.11	28.97	10.14	6.76	2.99
0.06	76.31	63.60	19.95	6.98	4.65	1.81
0.10	74.67	59.47	19.76	6.92	4.61	1.61
0.13	61.57	47.33	19.12	6.69	4.46	1.46
0.16	45.08	34.64	14.03	5.72	3.83	1.39
0.19	41.44	34.13	13.91	5.15	3.45	1.07
0.23	41.43	32.84	13.88	4.87	3.25	1.02
0.26	40.93	31.82	13.18	4.86	3.24	1.01
0.29	33.08	26.06	12.61	4.85	3.24	0.96
0.32	30.70	25.36	12.52	4.61	3.08	0.94
0.35	30.15	24.80	12.26	4.41	2.94	0.92
0.39	28.86	22.76	10.33	4.01	2.68	0.91
0.42	27.17	21.40	9.95	3.94	2.64	0.85
0.45	25.05	19.80	9.61	3.74	2.49	0.70
0.48	23.30	19.12	9.30	3.62	2.42	0.66
0.52	22.90	18.54	8.42	3.20	2.14	0.60
0.55	21.87	17.75	7.27	2.55	1.70	0.59
0.58	21.82	15.39	6.05	2.22	1.48	0.56
0.61	19.73	14.63	5.71	2.12	1.41	0.52
0.65	18.26	12.41	5.41	2.06	1.38	0.37
0.68	15.85	11.24	5.20	1.82	1.21	0.37
0.71	14.20	9.88	3.08	1.17	0.78	0.34
0.74	9.03	7.25	2.79	0.98	0.65	0.24
0.77	7.14	6.17	1.88	0.73	0.49	0.21
0.81	5.00	4.01	1.85	0.66	0.44	0.11
0.84	2.60	2.01	1.01	0.54	0.37	0.09
0.87	2.35	1.85	0.85	0.43	0.30	0.07
0.90	1.68	1.34	0.61	0.29	0.19	0.07
0.94	0.58	0.44	0.18	0.07	0.05	0.01
0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.10	73.36	58.26	19.70	6.89	4.60	1.60
					Average of	0.75

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: CAStraw
Metfile: w23234.dvf
PRZM scenario: CAStrawberry-noplastic no_irrig.txt
EXAMS environment file pond298.exv
Chemical Name: Chloropicrin

Description	Variable Nan	Value		Units	Comments
Molecular weight	mwt		164.4	g/mol	
Henry's Law Const.	henry		0.00205	atm-m^3/mol	
Vapor Pressure	vapr		23.8	torr	
Solubility	sol		1621	mg/L	
Kd	Kd			mg/L	
Koc	Koc		36.05	mg/L	
Photolysis half-life	kdp		1.3	days	Half-life
Aerobic Aquatic Metabol	kbacw		31.42	days	Halfife
Anaerobic Aquatic Metak	kbacs		0.05	days	Halfife
Aerobic Soil Metabolism	asm		15.71	days	Halfife
Hydrolysis:	pH 7		0	days	Half-life
Method:	CAM		8	integer	See PRZM manual
Incorporation Depth:	DEPI		25	cm	
Application Rate:	TAPP		560	kg/ha	
Application Efficiency:	APPEFF		1	fraction	
Spray Drift	DRFT		0	fraction of application rate applied to pond	
Application Date	Date	15-12		dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA				
	IPSCND		1		
	UPTKF				
Record 18:	PLVKRT				
	PLDKRT				
	FEXTRC		0		
Flag for Index Res. Run	IR	Pond			
Flag for runoff calc.	RUNOFF	none		none, monthly or total(average of entire run)	

stored as Nursery.out
Chemical: Chloropicrin
PRZM environment: CA modified Monday, 16 April 2007 at 14:26:46
EXAMS environment: p modified Thuday, 29 August 2002 at 16:33:30
Metfile: w23188.dvf modified Wedday, 3 July 2002 at 10:04:22
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.70	0.53	0.22	0.08	0.05	0.01
1962	37.29	28.71	12.11	4.49	3.00	0.74
1963	2.67	2.02	0.84	0.31	0.20	0.05
1964	0.11	0.08	0.03	0.01	0.01	0.00
1965	8.72	6.67	2.80	1.17	0.78	0.19
1966	0.00	0.00	0.00	0.00	0.00	0.00
1967	0.22	0.16	0.10	0.06	0.04	0.01
1968	35.82	26.96	10.88	3.97	2.65	0.65
1969	33.86	26.33	14.22	5.35	3.57	0.88
1970	109.00	82.95	33.95	12.36	8.24	2.03
1971	16.24	12.44	5.20	1.92	1.29	0.32
1972	0.00	0.00	0.00	0.00	0.00	0.00
1973	5.77	4.23	2.09	0.78	0.52	0.13
1974	9.16	7.01	3.11	1.14	0.76	0.19
1975	42.05	32.04	14.51	5.39	3.59	0.89
1976	15.12	11.37	4.58	1.72	1.15	0.28
1977	0.18	0.13	0.05	0.02	0.01	0.00
1978	23.24	17.29	9.32	3.61	2.41	0.59
1979	13.14	9.74	4.11	1.68	1.12	0.28
1980	26.60	19.58	8.83	3.77	2.52	0.62
1981	73.63	54.24	31.07	11.66	7.77	1.92
1982	29.98	21.95	10.35	3.79	2.52	0.62
1983	38.66	28.86	12.31	4.76	3.17	0.78
1984	0.04	0.03	0.01	0.00	0.00	0.00
1985	0.00	0.00	0.00	0.00	0.00	0.00
1986	4.64	3.66	2.14	0.93	0.63	0.16
1987	15.39	11.68	4.74	1.80	1.20	0.30
1988	0.82	0.66	0.30	0.11	0.08	0.02
1989	1.66	1.24	0.48	0.17	0.12	0.03
1990	9.64	7.43	3.14	1.16	0.77	0.19

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	109.00	82.95	33.95	12.36	8.24	2.03
0.06	73.63	54.24	31.07	11.66	7.77	1.92
0.10	42.05	32.04	14.51	5.39	3.59	0.89
0.13	38.66	28.86	14.22	5.35	3.57	0.88
0.16	37.29	28.71	12.31	4.76	3.17	0.78
0.19	35.82	26.96	12.11	4.49	3.00	0.74
0.23	33.86	26.33	10.88	3.97	2.65	0.65
0.26	29.98	21.95	10.35	3.79	2.52	0.62
0.29	26.60	19.58	9.32	3.77	2.52	0.62
0.32	23.24	17.29	8.83	3.61	2.41	0.59
0.35	16.24	12.44	5.20	1.92	1.29	0.32
0.39	15.39	11.68	4.74	1.80	1.20	0.30
0.42	15.12	11.37	4.58	1.72	1.15	0.28
0.45	13.14	9.74	4.11	1.68	1.12	0.28
0.48	9.64	7.43	3.14	1.17	0.78	0.19
0.52	9.16	7.01	3.11	1.16	0.77	0.19
0.55	8.72	6.67	2.80	1.14	0.76	0.19
0.58	5.77	4.23	2.14	0.93	0.63	0.16
0.61	4.64	3.66	2.09	0.78	0.52	0.13
0.65	2.67	2.02	0.84	0.31	0.20	0.05
0.68	1.66	1.24	0.48	0.17	0.12	0.03
0.71	0.82	0.66	0.30	0.11	0.08	0.02
0.74	0.70	0.53	0.22	0.08	0.05	0.01
0.77	0.22	0.16	0.10	0.06	0.04	0.01
0.81	0.18	0.13	0.05	0.02	0.01	0.00
0.84	0.11	0.08	0.03	0.01	0.01	0.00
0.87	0.04	0.03	0.01	0.00	0.00	0.00
0.90	0.00	0.00	0.00	0.00	0.00	0.00
0.94	0.00	0.00	0.00	0.00	0.00	0.00
0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.1	41.711	31.722	14.481	5.3849	3.5912	0.88543
					Average of	0.40

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: Nursery

Metfile:	w23188.dvf			
PRZM scenario:	CAnursery no_irrig.txt			
EXAMS environment fi	pond298.exv			
Chemical Name:	Chloropicrin			
Description	Variable Na	Value	Units	Comments
Molecular weight	mwt	164.4	g/mol	
Henry's Law Const.	henry	0.00205	atm-m^3/mol	
Vapor Pressure	vapr	23.8	torr	
Solubility	sol	1621	mg/L	
Kd	Kd		mg/L	
Koc	Koc	36.05	mg/L	
Photolysis half-life	kdp	1.3	days	Half-life
Aerobic Aquatic Metab	kbacw	31.42	days	Halfife
Anaerobic Aquatic Met	kbacs	0.05	days	Halfife
Aerobic Soil Metabolisr	asm	15.71	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	8	integer	See PRZM manual
Incorporation Depth:	DEPI	25	cm	
Application Rate:	TAPP	1205	kg/ha	
Application Efficiency:	APPEFF	1	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond	
Application Date	Date	15-02	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0		
Flag for Index Res. Ru	IR	Pond		
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)	

stored as Pota400.out
Chemical: Chloropicrin
PRZM envi modified Monday, 16 April 2007 at 08:57:34
EXAMS en modified Thuday, 29 August 2002 at 16:33:30
Metfile: w2 modified Wedday, 3 July 2002 at 10:04:20
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
1962	7.6E+00	6.1E+00	3.1E+00	1.2E+00	7.9E-01	1.9E-01
1963	1.3E+00	1.0E+00	4.5E-01	1.7E-01	1.1E-01	2.7E-02
1964	2.9E-07	2.1E-07	9.3E-08	3.5E-08	2.3E-08	5.8E-09
1965	8.6E-03	6.4E-03	2.6E-03	9.9E-04	6.6E-04	1.6E-04
1966	1.9E+01	1.5E+01	6.8E+00	2.6E+00	1.7E+00	4.2E-01
1967	1.8E-03	1.4E-03	7.0E-04	2.8E-04	1.9E-04	4.6E-05
1968	1.7E-06	1.3E-06	6.2E-07	2.5E-07	1.6E-07	4.1E-08
1969	4.7E-01	4.0E-01	1.9E-01	7.4E-02	5.0E-02	1.2E-02
1970	1.8E+00	1.4E+00	6.1E-01	2.3E-01	1.5E-01	3.7E-02
1971	1.2E-03	8.6E-04	3.0E-04	1.1E-04	7.0E-05	1.7E-05
1972	1.1E-05	7.2E-06	2.3E-06	8.1E-07	5.4E-07	1.4E-07
1973	4.8E-03	3.6E-03	1.5E-03	5.6E-04	3.7E-04	9.2E-05
1974	5.0E-02	3.8E-02	1.6E-02	6.0E-03	4.0E-03	9.8E-04
1975	1.8E+01	1.4E+01	6.6E+00	2.5E+00	1.7E+00	4.1E-01
1976	1.6E+00	1.2E+00	6.6E-01	2.5E-01	1.6E-01	4.0E-02
1977	1.1E-02	8.6E-03	3.5E-03	1.2E-03	8.3E-04	2.1E-04
1978	4.6E+01	3.8E+01	1.7E+01	6.4E+00	4.2E+00	1.0E+00
1979	5.2E-03	4.2E-03	1.9E-03	1.2E-03	8.2E-04	2.0E-04
1980	6.2E-02	4.8E-02	2.1E-02	8.0E-03	5.3E-03	1.3E-03
1981	2.9E-02	2.4E-02	1.1E-02	4.4E-03	2.9E-03	7.2E-04
1982	1.4E-02	1.1E-02	4.8E-03	1.8E-03	1.2E-03	2.9E-04
1983	1.1E-01	8.9E-02	3.9E-02	1.6E-02	1.1E-02	2.6E-03
1984	9.4E-08	7.5E-08	3.5E-08	1.6E-08	1.0E-08	4.3E-09
1985	1.1E-07	8.9E-08	4.8E-08	2.5E-08	1.7E-08	4.3E-09
1986	6.3E-03	5.2E-03	2.3E-03	1.2E-03	8.0E-04	2.0E-04
1987	5.7E-02	4.5E-02	2.1E-02	7.8E-03	5.2E-03	1.3E-03
1988	6.4E-10	4.5E-10	1.6E-10	5.9E-11	3.9E-11	9.6E-12
1989	1.7E+00	1.2E+00	4.1E-01	1.5E-01	9.8E-02	2.4E-02
1990	1.6E-27	1.2E-27	5.5E-28	2.1E-28	1.4E-28	3.5E-29

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	46.18	38.27	17.11	6.36	4.24	1.05
0.06	18.82	14.92	6.80	2.56	1.71	0.42
0.10	18.00	14.27	6.63	2.52	1.68	0.41
0.13	7.64	6.14	3.05	1.18	0.79	0.19
0.16	1.79	1.40	0.66	0.25	0.16	0.04
0.19	1.66	1.24	0.61	0.23	0.15	0.04
0.23	1.61	1.17	0.45	0.17	0.11	0.03
0.26	1.35	1.05	0.41	0.15	0.10	0.02
0.29	0.47	0.40	0.19	0.07	0.05	0.01
0.32	0.11	0.09	0.04	0.02	0.01	0.00
0.35	0.06	0.05	0.02	0.01	0.01	0.00
0.39	0.06	0.05	0.02	0.01	0.01	0.00
0.42	0.05	0.04	0.02	0.01	0.00	0.00
0.45	0.03	0.02	0.01	0.00	0.00	0.00
0.48	0.01	0.01	0.00	0.00	0.00	0.00
0.52	0.01	0.01	0.00	0.00	0.00	0.00
0.55	0.01	0.01	0.00	0.00	0.00	0.00
0.58	0.01	0.01	0.00	0.00	0.00	0.00
0.61	0.01	0.00	0.00	0.00	0.00	0.00
0.65	0.00	0.00	0.00	0.00	0.00	0.00
0.68	0.00	0.00	0.00	0.00	0.00	0.00
0.71	0.00	0.00	0.00	0.00	0.00	0.00
0.74	0.00	0.00	0.00	0.00	0.00	0.00
0.77	0.00	0.00	0.00	0.00	0.00	0.00
0.81	0.00	0.00	0.00	0.00	0.00	0.00
0.84	0.00	0.00	0.00	0.00	0.00	0.00
0.87	0.00	0.00	0.00	0.00	0.00	0.00
0.90	0.00	0.00	0.00	0.00	0.00	0.00
0.94	0.00	0.00	0.00	0.00	0.00	0.00
0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.10	16.96	13.46	6.27	2.38	1.59	0.39
					Average of	0.07

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: Pota400
Metfile: w23155.dvf
PRZM scei CAPotato no_irrig.txt
EXAMS en pond298.exv
Chemical I Chloropicrin

Descriptior	Variable Na	Value	Units	Comments
Molecular v	mwt	164.4	g/mol	
Henry's La	henry	0.00205	atm-m^3/mol	
Vapor Pres	vapr	23.8	torr	
Solubility	sol	1621	mg/L	
Kd	Kd		mg/L	
Koc	Koc	36.05	mg/L	
Photolysis	kdp	1.3	days	Half-life
Aerobic Aq	kbacw	31.42	days	Halfife
Anaerobic .	kbacs	0.05	days	Halfife
Aerobic So	asm	15.71	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	8	integer	See PRZM manual
Incorporati	DEPI	25	cm	
Application	TAPP	448	kg/ha	
Application	APPEFF	1	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond	
Application	Date	2-Jan	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0		
Flag for Inc	IR	Pond		
Flag for rur	RUNOFF	none	none, monthly or total(average of entire run)	

stored as OniDec31.out
Chemical: Chloropicrin
PRZM environment: CAc modified Tueday, 8 June 2004 at 11:01:56
EXAMS environment: po modified Thuday, 29 August 2002 at 16:33:30
Metfile: w23155.dvf modified Wedday, 3 July 2002 at 10:04:20
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.18	0.15	0.09	0.04	0.02	0.01
1963	0.20	0.16	0.07	0.03	0.02	0.00
1964	0.76	0.60	0.14	0.05	0.03	0.01
1965	11.91	7.80	1.49	0.52	0.35	0.13
1966	9.20	7.34	3.41	1.32	0.88	0.22
1967	0.99	0.84	0.37	0.13	0.09	0.02
1968	0.33	0.27	0.14	0.06	0.04	0.01
1969	0.05	0.04	0.02	0.01	0.01	0.00
1970	0.94	0.75	0.27	0.10	0.06	0.02
1971	5.24	4.14	1.25	0.44	0.29	0.09
1972	2.83	2.30	1.12	0.43	0.29	0.07
1973	1.40	1.11	0.62	0.25	0.17	0.04
1974	0.04	0.03	0.01	0.01	0.01	0.00
1975	0.05	0.04	0.02	0.01	0.01	0.00
1976	0.03	0.03	0.01	0.00	0.00	0.00
1977	17.31	13.17	2.93	1.02	0.68	0.26
1978	9.71	7.59	3.37	1.40	0.94	0.23
1979	1.39	1.10	0.54	0.21	0.14	0.03
1980	0.53	0.45	0.26	0.10	0.07	0.02
1981	0.10	0.08	0.04	0.02	0.01	0.00
1982	0.00	0.00	0.00	0.00	0.00	0.00
1983	10.85	8.85	2.57	0.90	0.60	0.18
1984	10.36	8.50	3.55	1.24	0.83	0.34
1985	2.73	2.28	1.21	0.49	0.33	0.08
1986	6.57	5.38	2.15	0.75	0.50	0.12
1987	11.48	9.87	5.05	2.06	1.37	0.34
1988	1.51	1.13	0.40	0.14	0.09	0.02
1989	0.24	0.18	0.08	0.03	0.02	0.01
1990	0.06	0.04	0.02	0.01	0.00	0.00

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	17.31	13.17	5.05	2.06	1.37	0.34
0.06	11.91	9.87	3.55	1.40	0.94	0.34
0.10	11.48	8.85	3.41	1.32	0.88	0.26
0.13	10.85	8.50	3.37	1.24	0.83	0.23
0.16	10.36	7.80	2.93	1.02	0.68	0.22
0.19	9.71	7.59	2.57	0.90	0.60	0.18
0.23	9.20	7.34	2.15	0.75	0.50	0.13
0.26	6.57	5.38	1.49	0.52	0.35	0.12
0.29	5.24	4.14	1.25	0.49	0.33	0.09
0.32	2.83	2.30	1.21	0.44	0.29	0.08
0.35	2.73	2.28	1.12	0.43	0.29	0.07
0.39	1.51	1.13	0.62	0.25	0.17	0.04
0.42	1.40	1.11	0.54	0.21	0.14	0.03
0.45	1.39	1.10	0.40	0.14	0.09	0.02
0.48	0.99	0.84	0.37	0.13	0.09	0.02
0.52	0.94	0.75	0.27	0.10	0.07	0.02
0.55	0.76	0.60	0.26	0.10	0.06	0.02
0.58	0.53	0.45	0.14	0.06	0.04	0.01
0.61	0.33	0.27	0.14	0.05	0.03	0.01
0.65	0.24	0.18	0.09	0.04	0.02	0.01
0.68	0.20	0.16	0.08	0.03	0.02	0.01
0.71	0.18	0.15	0.07	0.03	0.02	0.00
0.74	0.10	0.08	0.04	0.02	0.01	0.00
0.77	0.06	0.04	0.02	0.01	0.01	0.00
0.81	0.05	0.04	0.02	0.01	0.01	0.00
0.84	0.05	0.04	0.02	0.01	0.01	0.00
0.87	0.04	0.03	0.01	0.01	0.00	0.00
0.90	0.03	0.03	0.01	0.00	0.00	0.00
0.94	0.00	0.00	0.00	0.00	0.00	0.00
0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.10	11.42	8.82	3.41	1.31	0.87	0.26
					Average of	0.08

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: OniDec31

Metfile:	w23155.dvf			
PRZM scenario:	CAonion_NirrigC.txt			
EXAMS environment file	pond298.exv			
Chemical Name:	Chloropicrin			
Description	Variable Nan	Value	Units	Comments
Molecular weight	mwt	164.4	g/mol	
Henry's Law Const.	henry	0.00205	atm-m^3/mol	
Vapor Pressure	vapr	23.8	torr	
Solubility	sol	1621	mg/L	
Kd	Kd		mg/L	
Koc	Koc	36.05	mg/L	
Photolysis half-life	kdp	1.3	days	Half-life
Aerobic Aquatic Metaboli	kbacw	31.42	days	Halfife
Anaerobic Aquatic Metat	kbacs	0.05	days	Halfife
Aerobic Soil Metabolism	asm	15.71	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	8	integer	See PRZM manual
Incorporation Depth:	DEPI	25	cm	
Application Rate:	TAPP	448	kg/ha	
Application Efficiency:	APPEFF	1	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond	
Application Date	Date	15-12	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0		
Flag for Index Res. Run	IR	Pond		
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)	

stored as TomFeb15.out
Chemical: Chloropicrin
PRZM environment: CAt modified Tueday, 8 June 2004 at 11:42:50
EXAMS environment: po modified Thuday, 29 August 2002 at 16:33:30
Metfile: w93193.dvf modified Wedday, 3 July 2002 at 10:04:24
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.07	0.06	0.02	0.02	0.01	0.00
1962	0.11	0.09	0.04	0.01	0.01	0.00
1963	1.83	1.42	0.76	0.37	0.25	0.06
1964	0.00	0.00	0.00	0.00	0.00	0.00
1965	6.22	4.86	2.23	0.92	0.61	0.15
1966	0.00	0.00	0.00	0.00	0.00	0.00
1967	0.56	0.44	0.21	0.12	0.08	0.02
1968	0.83	0.66	0.31	0.13	0.09	0.02
1969	0.40	0.30	0.12	0.04	0.03	0.01
1970	0.88	0.70	0.34	0.13	0.08	0.02
1971	3.23	2.41	0.95	0.35	0.23	0.06
1972	0.14	0.10	0.03	0.01	0.01	0.00
1973	0.11	0.09	0.04	0.03	0.02	0.00
1974	1.00	0.77	0.32	0.23	0.15	0.04
1975	0.07	0.05	0.02	0.01	0.01	0.00
1976	0.01	0.01	0.00	0.00	0.00	0.00
1977	0.22	0.17	0.08	0.03	0.03	0.01
1978	0.82	0.62	0.32	0.16	0.11	0.03
1979	0.11	0.09	0.04	0.01	0.01	0.00
1980	0.00	0.00	0.00	0.00	0.00	0.00
1981	0.72	0.56	0.24	0.09	0.06	0.02
1982	1.56	1.34	0.69	0.29	0.19	0.05
1983	0.12	0.08	0.03	0.01	0.01	0.00
1984	0.00	0.00	0.00	0.00	0.00	0.00
1985	0.18	0.14	0.06	0.02	0.02	0.00
1986	0.35	0.27	0.15	0.06	0.04	0.01
1987	0.66	0.54	0.28	0.11	0.08	0.02
1988	1.67	1.33	0.58	0.27	0.19	0.05
1989	3.67	2.80	1.16	0.71	0.48	0.12
1990	2.01	1.49	0.57	0.21	0.14	0.03

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	6.22	4.86	2.23	0.92	0.61	0.15
0.06	3.67	2.80	1.16	0.71	0.48	0.12
0.10	3.23	2.41	0.95	0.37	0.25	0.06
0.13	2.01	1.49	0.76	0.35	0.23	0.06
0.16	1.83	1.42	0.69	0.29	0.19	0.05
0.19	1.67	1.34	0.58	0.27	0.19	0.05
0.23	1.56	1.33	0.57	0.23	0.15	0.04
0.26	1.00	0.77	0.34	0.21	0.14	0.03
0.29	0.88	0.70	0.32	0.16	0.11	0.03
0.32	0.83	0.66	0.32	0.13	0.09	0.02
0.35	0.82	0.62	0.31	0.13	0.08	0.02
0.39	0.72	0.56	0.28	0.12	0.08	0.02
0.42	0.66	0.54	0.24	0.11	0.08	0.02
0.45	0.56	0.44	0.21	0.09	0.06	0.02
0.48	0.40	0.30	0.15	0.06	0.04	0.01
0.52	0.35	0.27	0.12	0.04	0.03	0.01
0.55	0.22	0.17	0.08	0.03	0.03	0.01
0.58	0.18	0.14	0.06	0.03	0.02	0.00
0.61	0.14	0.10	0.04	0.02	0.02	0.00
0.65	0.12	0.09	0.04	0.02	0.01	0.00
0.68	0.11	0.09	0.04	0.01	0.01	0.00
0.71	0.11	0.09	0.03	0.01	0.01	0.00
0.74	0.11	0.08	0.03	0.01	0.01	0.00
0.77	0.07	0.06	0.02	0.01	0.01	0.00
0.81	0.07	0.05	0.02	0.01	0.01	0.00
0.84	0.01	0.01	0.00	0.00	0.00	0.00
0.87	0.00	0.00	0.00	0.00	0.00	0.00
0.90	0.00	0.00	0.00	0.00	0.00	0.00
0.94	0.00	0.00	0.00	0.00	0.00	0.00
0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.10	3.11	2.32	0.93	0.37	0.24	0.06
					Average of	0.02

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: TomFeb15

Metfile:	w93193.dvf			
PRZM scenario:	CAtomato_NirrigC.txt			
EXAMS environment file	pond298.exv			
Chemical Name:	Chloropicrin			
Description	Variable Na	Value	Units	Comments
Molecular weight	mwt	164.4	g/mol	
Henry's Law Const.	henry	0.00205	atm-m^3/mol	
Vapor Pressure	vapr	23.8	torr	
Solubility	sol	1621	mg/L	
Kd	Kd		mg/L	
Koc	Koc	36.05	mg/L	
Photolysis half-life	kdp	1.3	days	Half-life
Aerobic Aquatic Metabol	kbacw	31.42	days	Halfife
Anaerobic Aquatic Metat	kbacs	0.05	days	Halfife
Aerobic Soil Metabolism	asm	15.71	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	8	integer	See PRZM manual
Incorporation Depth:	DEPI	25	cm	
Application Rate:	TAPP	560	kg/ha	
Application Efficiency:	APPEFF	1	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond	
Application Date	Date	15-02	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0		
Flag for Index Res. Run	IR	Pond		
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)	

stored as RowDec15.out						
Chemical: Chloropicrin						
PRZM environment: CAF	modified Monday, 16 April 2007 at 08:57:07					
EXAMS environment: pc	modified Thuday, 29 August 2002 at 16:33:30					
Metfile: w23234.dvf	modified Wedday, 3 July 2002 at 10:04:22					
Water segment concentrations (ppb)						
Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.47	0.36	0.18	0.11	0.08	0.02
1963	0.39	0.32	0.14	0.06	0.04	0.01
1964	1.71	1.34	0.58	0.21	0.14	0.04
1965	0.73	0.61	0.20	0.07	0.05	0.01
1966	0.50	0.41	0.21	0.09	0.06	0.01
1967	0.89	0.71	0.35	0.13	0.09	0.02
1968	0.62	0.52	0.24	0.11	0.08	0.02
1969	0.59	0.46	0.23	0.10	0.07	0.02
1970	0.56	0.42	0.19	0.07	0.05	0.01
1971	0.66	0.53	0.17	0.06	0.04	0.01
1972	0.26	0.21	0.10	0.04	0.03	0.01
1973	0.65	0.56	0.31	0.14	0.09	0.03
1974	0.55	0.43	0.12	0.05	0.03	0.01
1975	0.36	0.28	0.11	0.08	0.05	0.01
1976	4.90	2.21	0.42	0.15	0.10	0.02
1977	4.82	4.02	2.02	0.78	0.52	0.13
1978	0.25	0.21	0.14	0.06	0.04	0.01
1979	2.48	1.98	0.68	0.26	0.17	0.08
1980	0.96	0.76	0.47	0.19	0.13	0.03
1981	1.32	1.05	0.63	0.24	0.16	0.04
1982	1.39	1.12	0.41	0.18	0.13	0.06
1983	0.58	0.46	0.14	0.10	0.06	0.02
1984	0.19	0.15	0.07	0.03	0.02	0.00
1985	0.14	0.11	0.04	0.02	0.01	0.00
1986	0.35	0.28	0.13	0.07	0.05	0.01
1987	3.18	2.48	1.09	0.42	0.28	0.07
1988	0.57	0.46	0.20	0.07	0.05	0.02
1989	0.20	0.16	0.07	0.03	0.02	0.00
1990	0.26	0.21	0.10	0.06	0.04	0.01
Sorted results						
Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	4.90	4.02	2.02	0.78	0.52	0.13
0.06	4.82	2.48	1.09	0.42	0.28	0.08
0.10	3.18	2.21	0.68	0.26	0.17	0.07
0.13	2.48	1.98	0.63	0.24	0.16	0.06
0.16	1.71	1.34	0.58	0.21	0.14	0.04
0.19	1.39	1.12	0.47	0.19	0.13	0.04
0.23	1.32	1.05	0.42	0.18	0.13	0.03
0.26	0.96	0.76	0.41	0.15	0.10	0.03
0.29	0.89	0.71	0.35	0.14	0.09	0.02
0.32	0.73	0.61	0.31	0.13	0.09	0.02
0.35	0.66	0.56	0.24	0.11	0.08	0.02
0.39	0.65	0.53	0.23	0.11	0.08	0.02
0.42	0.62	0.52	0.21	0.10	0.07	0.02
0.45	0.59	0.46	0.20	0.10	0.06	0.02
0.48	0.58	0.46	0.20	0.09	0.06	0.02
0.52	0.57	0.46	0.19	0.08	0.05	0.01
0.55	0.56	0.43	0.18	0.07	0.05	0.01
0.58	0.55	0.42	0.17	0.07	0.05	0.01
0.61	0.50	0.41	0.14	0.07	0.05	0.01
0.65	0.47	0.36	0.14	0.07	0.05	0.01
0.68	0.39	0.32	0.14	0.06	0.04	0.01
0.71	0.36	0.28	0.13	0.06	0.04	0.01
0.74	0.35	0.28	0.12	0.06	0.04	0.01
0.77	0.26	0.21	0.11	0.06	0.04	0.01
0.81	0.26	0.21	0.10	0.05	0.03	0.01
0.84	0.25	0.21	0.10	0.04	0.03	0.01
0.87	0.20	0.16	0.07	0.03	0.02	0.00
0.90	0.19	0.15	0.07	0.03	0.02	0.00
0.94	0.14	0.11	0.04	0.02	0.01	0.00
0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.10	3.11	2.19	0.67	0.26	0.17	0.07
					Average of :	0.03
Inputs generated by pe4.pl - 8-August-2003						
Data used for this run:						
Output File: RowDec15						
Metfile:	w23234.dvf					
PRZM scenario:	CARowCrop no_irrig.txt					
EXAMS environment file	pond298.exv					
Chemical Name:	Chloropicrin					
Description	Variable Nar	Value	Units	Comments		
Molecular weight	mwt	164.4	g/mol			
Henry's Law Const.	henry	0.00205	atm-m^3/mol			
Vapor Pressure	vapr	23.8	torr			
Solubility	sol	1621	mg/L			
Kd	Kd		mg/L			
Koc	Koc	36.05	mg/L			
Photolysis half-life	kdp	1.3	days	Half-life		
Aerobic Aquatic Metabo	kbacw	31.42	days	Halfife		
Anaerobic Aquatic Meta	kbacs	0.05	days	Halfife		
Aerobic Soil Metabolism	asm	15.71	days	Halfife		
Hydrolysis:	pH 7	0	days	Half-life		
Method:	CAM	8	integer	See PRZM manual		
Incorporation Depth:	DEPI	25	cm			
Application Rate:	TAPP	560	kg/ha			
Application Efficiency:	APPEFF	1	fraction			
Spray Drift	DRFT	0	fraction of application rate applied to pond			
Application Date	Date	15-12	dd/mm or dd/mmm or dd-mm or dd-mmm			
Record 17:	FILTRA					
	IPSCND	1				
	UPTKF					
Record 18:	PLVKRT					
	PLDKRT					
	FEXTRC	0				
Flag for Index Res. Run	IR	Pond				
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)			

stored as ColeDec15.out
Chemical: Chloropicrin
PRZM environment: C. modified Monday, 16 April 2007 at 08:58:22
EXAMS environment: | modified Thuday, 29 August 2002 at 16:33:30
Metfile: w23234.dvf modified Wedday, 3 July 2002 at 10:04:22
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.00	0.00	0.00	0.00	0.00	0.00
1963	0.00	0.00	0.00	0.00	0.00	0.00
1964	0.01	0.01	0.00	0.00	0.00	0.00
1965	0.00	0.00	0.00	0.00	0.00	0.00
1966	0.00	0.00	0.00	0.00	0.00	0.00
1967	0.00	0.00	0.00	0.00	0.00	0.00
1968	0.00	0.00	0.00	0.00	0.00	0.00
1969	0.00	0.00	0.00	0.00	0.00	0.00
1970	0.00	0.00	0.00	0.00	0.00	0.00
1971	0.20	0.15	0.06	0.02	0.02	0.00
1972	0.00	0.00	0.00	0.00	0.00	0.00
1973	0.00	0.00	0.00	0.00	0.00	0.00
1974	0.00	0.00	0.00	0.00	0.00	0.00
1975	0.00	0.00	0.00	0.00	0.00	0.00
1976	0.12	0.10	0.04	0.02	0.01	0.00
1977	0.07	0.05	0.02	0.01	0.00	0.00
1978	0.00	0.00	0.00	0.00	0.00	0.00
1979	0.00	0.00	0.00	0.00	0.00	0.00
1980	0.00	0.00	0.00	0.00	0.00	0.00
1981	0.01	0.01	0.00	0.00	0.00	0.00
1982	0.00	0.00	0.00	0.00	0.00	0.00
1983	0.00	0.00	0.00	0.00	0.00	0.00
1984	0.01	0.01	0.00	0.00	0.00	0.00
1985	0.04	0.03	0.01	0.01	0.00	0.00
1986	0.00	0.00	0.00	0.00	0.00	0.00
1987	0.00	0.00	0.00	0.00	0.00	0.00
1988	0.13	0.09	0.04	0.01	0.01	0.00
1989	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.01	0.00	0.00	0.00	0.00	0.00

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	0.20	0.15	0.06	0.02	0.02	0.00
0.06	0.13	0.10	0.04	0.02	0.01	0.00
0.10	0.12	0.09	0.04	0.01	0.01	0.00
0.13	0.07	0.05	0.02	0.01	0.00	0.00
0.16	0.04	0.03	0.01	0.01	0.00	0.00
0.19	0.01	0.01	0.00	0.00	0.00	0.00
0.23	0.01	0.01	0.00	0.00	0.00	0.00
0.26	0.01	0.01	0.00	0.00	0.00	0.00
0.29	0.01	0.00	0.00	0.00	0.00	0.00
0.32	0.00	0.00	0.00	0.00	0.00	0.00
0.35	0.00	0.00	0.00	0.00	0.00	0.00
0.39	0.00	0.00	0.00	0.00	0.00	0.00
0.42	0.00	0.00	0.00	0.00	0.00	0.00
0.45	0.00	0.00	0.00	0.00	0.00	0.00
0.48	0.00	0.00	0.00	0.00	0.00	0.00
0.52	0.00	0.00	0.00	0.00	0.00	0.00
0.55	0.00	0.00	0.00	0.00	0.00	0.00
0.58	0.00	0.00	0.00	0.00	0.00	0.00
0.61	0.00	0.00	0.00	0.00	0.00	0.00
0.65	0.00	0.00	0.00	0.00	0.00	0.00
0.68	0.00	0.00	0.00	0.00	0.00	0.00
0.71	0.00	0.00	0.00	0.00	0.00	0.00
0.74	0.00	0.00	0.00	0.00	0.00	0.00
0.77	0.00	0.00	0.00	0.00	0.00	0.00
0.81	0.00	0.00	0.00	0.00	0.00	0.00
0.84	0.00	0.00	0.00	0.00	0.00	0.00
0.87	0.00	0.00	0.00	0.00	0.00	0.00
0.90	0.00	0.00	0.00	0.00	0.00	0.00
0.94	0.00	0.00	0.00	0.00	0.00	0.00
0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.10	0.12	0.09	0.03	0.01	0.01	0.00
					Average of	0.00

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: ColeDec15

Metfile:	w23234.dvf			
PRZM scenario:	CAColeCrop no_irrig.txt			
EXAMS environment fi	pond298.exv			
Chemical Name:	Chloropicrin			
Description	Variable Na	Value	Units	Comments
Molecular weight	mwt	164.4	g/mol	
Henry's Law Const.	henry	0.00205	atm-m^3/mol	
Vapor Pressure	vapr	23.8	torr	
Solubility	sol	1621	mg/L	
Kd	Kd		mg/L	
Koc	Koc	36.05	mg/L	
Photolysis half-life	kdp	1.3	days	Half-life
Aerobic Aquatic Metab	kbacw	31.42	days	Halfife
Anaerobic Aquatic Met	kbacs	0.05	days	Halfife
Aerobic Soil Metabolisı	asm	15.71	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	8	integer	See PRZM manual
Incorporation Depth:	DEPI	25	cm	
Application Rate:	TAPP	560	kg/ha	
Application Efficiency:	APPEFF	1	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond	
Application Date	Date	15-12	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0		
Flag for Index Res. Ru	IR	Pond		
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)	

stored as Melon.out
Chemical: Chloropicrin
PRZM envi modified Monday, 16 April 2007 at 08:58:00
EXAMS en modified Thuday, 29 August 2002 at 16:33:30
Metfile: w9 modified Wedday, 3 July 2002 at 10:04:24
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.00	0.00	0.00	0.00	0.00	0.00
1963	0.00	0.00	0.00	0.00	0.00	0.00
1964	0.00	0.00	0.00	0.00	0.00	0.00
1965	0.00	0.00	0.00	0.00	0.00	0.00
1966	0.00	0.00	0.00	0.00	0.00	0.00
1967	0.00	0.00	0.00	0.00	0.00	0.00
1968	0.00	0.00	0.00	0.00	0.00	0.00
1969	0.00	0.00	0.00	0.00	0.00	0.00
1970	0.00	0.00	0.00	0.00	0.00	0.00
1971	0.03	0.02	0.01	0.00	0.00	0.00
1972	0.01	0.01	0.00	0.00	0.00	0.00
1973	0.00	0.00	0.00	0.00	0.00	0.00
1974	0.00	0.00	0.00	0.00	0.00	0.00
1975	0.00	0.00	0.00	0.00	0.00	0.00
1976	0.00	0.00	0.00	0.00	0.00	0.00
1977	0.09	0.06	0.02	0.01	0.01	0.00
1978	0.00	0.00	0.00	0.00	0.00	0.00
1979	0.00	0.00	0.00	0.00	0.00	0.00
1980	0.00	0.00	0.00	0.00	0.00	0.00
1981	0.00	0.00	0.00	0.00	0.00	0.00
1982	0.00	0.00	0.00	0.00	0.00	0.00
1983	0.00	0.00	0.00	0.00	0.00	0.00
1984	0.00	0.00	0.00	0.00	0.00	0.00
1985	0.00	0.00	0.00	0.00	0.00	0.00
1986	0.00	0.00	0.00	0.00	0.00	0.00
1987	0.07	0.05	0.02	0.01	0.00	0.00
1988	0.00	0.00	0.00	0.00	0.00	0.00
1989	0.02	0.01	0.00	0.00	0.00	0.00
1990	0.21	0.15	0.05	0.02	0.01	0.00

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	0.21	0.15	0.05	0.02	0.01	0.00
0.06	0.09	0.06	0.02	0.01	0.01	0.00
0.10	0.07	0.05	0.02	0.01	0.00	0.00
0.13	0.03	0.02	0.01	0.00	0.00	0.00
0.16	0.02	0.01	0.00	0.00	0.00	0.00
0.19	0.01	0.01	0.00	0.00	0.00	0.00
0.23	0.00	0.00	0.00	0.00	0.00	0.00
0.26	0.00	0.00	0.00	0.00	0.00	0.00
0.29	0.00	0.00	0.00	0.00	0.00	0.00
0.32	0.00	0.00	0.00	0.00	0.00	0.00
0.35	0.00	0.00	0.00	0.00	0.00	0.00
0.39	0.00	0.00	0.00	0.00	0.00	0.00
0.42	0.00	0.00	0.00	0.00	0.00	0.00
0.45	0.00	0.00	0.00	0.00	0.00	0.00
0.48	0.00	0.00	0.00	0.00	0.00	0.00
0.52	0.00	0.00	0.00	0.00	0.00	0.00
0.55	0.00	0.00	0.00	0.00	0.00	0.00
0.58	0.00	0.00	0.00	0.00	0.00	0.00
0.61	0.00	0.00	0.00	0.00	0.00	0.00
0.65	0.00	0.00	0.00	0.00	0.00	0.00
0.68	0.00	0.00	0.00	0.00	0.00	0.00
0.71	0.00	0.00	0.00	0.00	0.00	0.00
0.74	0.00	0.00	0.00	0.00	0.00	0.00
0.77	0.00	0.00	0.00	0.00	0.00	0.00
0.81	0.00	0.00	0.00	0.00	0.00	0.00
0.84	0.00	0.00	0.00	0.00	0.00	0.00
0.87	0.00	0.00	0.00	0.00	0.00	0.00
0.90	0.00	0.00	0.00	0.00	0.00	0.00
0.94	0.00	0.00	0.00	0.00	0.00	0.00
0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.10	0.07	0.05	0.02	0.01	0.00	0.00
					Average of	0.00

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: Melon
Metfile: w93193.dvf
PRZM scei CAMelons no_irrig.txt
EXAMS en pond298.exv
Chemical N Chloropicrin

Descriptior	Variable Na	Value	Units	Comments
Molecular v	mwt	164.4	g/mol	
Henry's La	henry	0.00205	atm-m^3/mol	
Vapor Pres	vapr	23.8	torr	
Solubility	sol	1621	mg/L	
Kd	Kd		mg/L	
Koc	Koc	36.05	mg/L	
Photolysis	kdp	1.3	days	Half-life
Aerobic Aq	kbacw	31.42	days	Halfife
Anaerobic .	kbacs	0.05	days	Halfife
Aerobic So	asm	15.71	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	8	integer	See PRZM manual
Incorporati	DEPI	25	cm	
Application	TAPP	560	kg/ha	
Application	APPEFF	1	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond	
Application	Date	5-Jan	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0		
Flag for Inc	IR	Pond		
Flag for rur	RUNOFF	none	none, monthly or total(average of entire run)	

stored as Turf.out
Chemical: Chloropicrin
PRZM envi modified Monday, 16 April 2007 at 08:56:44
EXAMS en modified Thuday, 29 August 2002 at 16:33:30
Metfile: w2 modified Wedday, 3 July 2002 at 10:04:22
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0	0	0	0	0	0
1962	8.06E-05	6.16E-05	2.85E-05	1.69E-05	1.13E-05	2.79E-06
1963	4.14E-05	3.27E-05	1.45E-05	5.53E-06	3.71E-06	9.15E-07
1964	8.06E-05	6.29E-05	2.70E-05	9.93E-06	6.62E-06	1.63E-06
1965	1.94E-08	1.58E-08	5.50E-09	1.93E-09	1.28E-09	4.12E-10
1966	1.43E-08	1.17E-08	5.44E-09	3.54E-09	2.38E-09	5.89E-10
1967	0.0002173	0.0001711	7.91E-05	2.98E-05	1.99E-05	4.90E-06
1968	5.30E-06	4.19E-06	2.16E-06	1.14E-06	7.67E-07	1.89E-07
1969	2.92E-09	2.30E-09	1.09E-09	4.20E-10	2.80E-10	6.91E-11
1970	4.09E-08	3.09E-08	1.29E-08	4.78E-09	3.19E-09	7.87E-10
1971	3.59E-06	2.70E-06	1.09E-06	3.96E-07	2.64E-07	6.52E-08
1972	5.54E-08	4.20E-08	1.75E-08	6.65E-09	4.44E-09	1.09E-09
1973	4.93E-07	3.87E-07	2.48E-07	9.86E-08	6.58E-08	1.62E-08
1974	3.28E-07	2.55E-07	9.18E-08	4.73E-08	3.16E-08	1.11E-08
1975	6.19E-05	4.72E-05	1.87E-05	6.90E-06	4.61E-06	1.14E-06
1976	0.000699	0.0005773	0.0002417	8.80E-05	5.87E-05	1.45E-05
1977	4.60E-05	3.40E-05	1.32E-05	4.75E-06	3.52E-06	9.11E-07
1978	6.38E-11	5.24E-11	2.91E-11	1.67E-11	1.21E-11	3.04E-12
1979	3.12E-05	2.45E-05	1.54E-05	7.39E-06	4.96E-06	1.23E-06
1980	1.04E-07	8.59E-08	5.01E-08	2.64E-08	1.97E-08	4.84E-09
1981	0.000532	0.0004211	0.0002146	8.10E-05	5.40E-05	1.33E-05
1982	1.38E-06	1.07E-06	4.58E-07	1.74E-07	1.17E-07	2.90E-08
1983	4.16E-06	3.55E-06	2.01E-06	7.89E-07	5.26E-07	1.30E-07
1984	1.20E-08	8.99E-09	4.49E-09	2.13E-09	1.44E-09	3.55E-10
1985	0.000407	0.0003103	0.0001288	4.93E-05	3.30E-05	8.13E-06
1986	2.63E-07	2.12E-07	9.94E-08	4.74E-08	3.47E-08	8.56E-09
1987	1.63E-05	1.36E-05	5.76E-06	2.11E-06	1.41E-06	3.47E-07
1988	5.40E-06	3.94E-06	1.45E-06	5.10E-07	3.40E-07	8.51E-08
1989	5.68E-07	4.20E-07	2.23E-07	1.07E-07	7.21E-08	1.80E-08
1990	6.44E-05	4.93E-05	2.06E-05	8.37E-06	5.70E-06	1.44E-06

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032	0.00	0.00	0.00	0.00	0.00	0.00
0.065	0.00	0.00	0.00	0.00	0.00	0.00
0.097	0.00	0.00	0.00	0.00	0.00	0.00
0.129	0.00	0.00	0.00	0.00	0.00	0.00
0.161	0.00	0.00	0.00	0.00	0.00	0.00
0.194	0.00	0.00	0.00	0.00	0.00	0.00
0.226	0.00	0.00	0.00	0.00	0.00	0.00
0.258	0.00	0.00	0.00	0.00	0.00	0.00
0.290	0.00	0.00	0.00	0.00	0.00	0.00
0.323	0.00	0.00	0.00	0.00	0.00	0.00
0.355	0.00	0.00	0.00	0.00	0.00	0.00
0.387	0.00	0.00	0.00	0.00	0.00	0.00
0.419	0.00	0.00	0.00	0.00	0.00	0.00
0.452	0.00	0.00	0.00	0.00	0.00	0.00
0.484	0.00	0.00	0.00	0.00	0.00	0.00
0.516	0.00	0.00	0.00	0.00	0.00	0.00
0.548	0.00	0.00	0.00	0.00	0.00	0.00
0.581	0.00	0.00	0.00	0.00	0.00	0.00
0.613	0.00	0.00	0.00	0.00	0.00	0.00
0.645	0.00	0.00	0.00	0.00	0.00	0.00
0.677	0.00	0.00	0.00	0.00	0.00	0.00
0.710	0.00	0.00	0.00	0.00	0.00	0.00
0.742	0.00	0.00	0.00	0.00	0.00	0.00
0.774	0.00	0.00	0.00	0.00	0.00	0.00
0.806	0.00	0.00	0.00	0.00	0.00	0.00
0.839	0.00	0.00	0.00	0.00	0.00	0.00
0.871	0.00	0.00	0.00	0.00	0.00	0.00
0.903	0.00	0.00	0.00	0.00	0.00	0.00
0.935	0.00	0.00	0.00	0.00	0.00	0.00
0.968	0.00	0.00	0.00	0.00	0.00	0.00
0.100	0.00	0.00	0.00	0.00	0.00	0.00
					Average of y	1.7E-06

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: Turf
Metfile: w23234.dvf
PRZM scei CATurf no_irrig.txt
EXAMS en pond298.exv
Chemical N Chloropicrin

Descriptior	Variable Nan	Value	Units	Comments
Molecular v	mwt	164.4	g/mol	
Henry's La	henry	0.00205	atm-m^3/mol	
Vapor Pres	vapr	23.8	torr	
Solubility	sol	1621	mg/L	
Kd	Kd		mg/L	
Koc	Koc	36.05	mg/L	
Photolysis	kdp	1.3	days	Half-life
Aerobic Aq	kbacw	31.42	days	Halfife
Anaerobic .	kbacs	0.05	days	Halfife
Aerobic So	asm	15.71	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	8	integer	See PRZM manual
Incorporati	DEPI	25	cm	
Application	TAPP	990.5	kg/ha	
Application	APPEFF	1	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond	
Application	Date	15-12	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0		
Flag for Inc	IR	Pond		
Flag for rur	RUNOFF	none	none, monthly or total(average of entire run)	

stored as BerryD15.out
Chemical: Chloropicrin
PRZM envi modified Monday, 16 April 2007 at 08:56:19
EXAMS en modified Thuday, 29 August 2002 at 16:33:30
Metfile: w2 modified Wedday, 3 July 2002 at 10:04:22
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0	0	0	0	0	0
1962	5.88E-06	4.79E-06	1.82E-06	6.55E-07	4.39E-07	1.09E-07
1963	5.57E-07	4.09E-07	2.20E-07	8.69E-08	5.93E-08	2.55E-08
1964	3.22E-07	2.36E-07	1.29E-07	5.19E-08	3.48E-08	9.48E-09
1965	9.18E-07	6.70E-07	3.06E-07	1.19E-07	7.93E-08	2.69E-08
1966	5.14E-07	4.12E-07	2.38E-07	9.75E-08	6.50E-08	1.64E-08
1967	3.23E-07	2.50E-07	1.07E-07	3.94E-08	2.63E-08	9.53E-09
1968	5.50E-07	4.17E-07	1.71E-07	7.20E-08	4.80E-08	1.26E-08
1969	1.60E-06	1.14E-06	4.12E-07	1.50E-07	9.99E-08	2.52E-08
1970	1.38E-07	1.09E-07	5.01E-08	2.84E-08	1.89E-08	5.37E-09
1971	6.87E-07	5.16E-07	2.78E-07	1.10E-07	7.36E-08	2.14E-08
1972	6.14E-06	4.65E-06	1.97E-06	7.58E-07	5.06E-07	1.55E-07
1973	5.40E-07	4.02E-07	2.06E-07	1.20E-07	8.14E-08	2.02E-08
1974	2.97E-06	2.31E-06	5.20E-07	1.83E-07	1.22E-07	3.33E-08
1975	0.002801	0.002145	0.000849	0.000316	0.000212	5.24E-05
1976	0.008254	0.006628	0.002727	0.000992	0.000661	0.000163
1977	0.000311	0.000231	8.97E-05	3.22E-05	2.16E-05	5.57E-06
1978	4.03E-08	3.11E-08	1.36E-08	5.19E-09	3.46E-09	1.87E-09
1979	9.16E-05	6.97E-05	3.20E-05	1.45E-05	1.07E-05	2.67E-06
1980	7.29E-07	5.97E-07	2.86E-07	1.06E-07	7.36E-08	2.26E-08
1981	0.002671	0.002114	0.001185	0.00047	0.000315	7.77E-05
1982	1.06E-06	7.71E-07	3.05E-07	1.83E-07	1.25E-07	3.15E-08
1983	2.80E-07	2.24E-07	1.23E-07	4.81E-08	3.21E-08	8.70E-09
1984	1.38E-06	1.04E-06	5.51E-07	2.98E-07	2.01E-07	4.96E-08
1985	1.47E-06	1.13E-06	5.16E-07	1.96E-07	1.31E-07	4.93E-08
1986	2.01E-08	1.59E-08	9.05E-09	3.86E-09	2.67E-09	6.99E-10
1987	0.000669	0.000556	0.000234	8.62E-05	5.76E-05	1.42E-05
1988	0.000248	0.000183	6.91E-05	2.44E-05	1.63E-05	4.01E-06
1989	3.89E-06	2.85E-06	1.12E-06	5.88E-07	4.52E-07	1.30E-07
1990	0.000763	0.000529	0.000175	6.44E-05	4.31E-05	2.04E-05

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	0.01	0.01	0.00	0.00	0.00	0.00
0.06	0.00	0.00	0.00	0.00	0.00	0.00
0.10	0.00	0.00	0.00	0.00	0.00	0.00
0.13	0.00	0.00	0.00	0.00	0.00	0.00
0.16	0.00	0.00	0.00	0.00	0.00	0.00
0.19	0.00	0.00	0.00	0.00	0.00	0.00
0.23	0.00	0.00	0.00	0.00	0.00	0.00
0.26	0.00	0.00	0.00	0.00	0.00	0.00
0.29	0.00	0.00	0.00	0.00	0.00	0.00
0.32	0.00	0.00	0.00	0.00	0.00	0.00
0.35	0.00	0.00	0.00	0.00	0.00	0.00
0.39	0.00	0.00	0.00	0.00	0.00	0.00
0.42	0.00	0.00	0.00	0.00	0.00	0.00
0.45	0.00	0.00	0.00	0.00	0.00	0.00
0.48	0.00	0.00	0.00	0.00	0.00	0.00
0.52	0.00	0.00	0.00	0.00	0.00	0.00
0.55	0.00	0.00	0.00	0.00	0.00	0.00
0.58	0.00	0.00	0.00	0.00	0.00	0.00
0.61	0.00	0.00	0.00	0.00	0.00	0.00
0.65	0.00	0.00	0.00	0.00	0.00	0.00
0.68	0.00	0.00	0.00	0.00	0.00	0.00
0.71	0.00	0.00	0.00	0.00	0.00	0.00
0.74	0.00	0.00	0.00	0.00	0.00	0.00
0.77	0.00	0.00	0.00	0.00	0.00	0.00
0.81	0.00	0.00	0.00	0.00	0.00	0.00
0.84	0.00	0.00	0.00	0.00	0.00	0.00
0.87	0.00	0.00	0.00	0.00	0.00	0.00
0.90	0.00	0.00	0.00	0.00	0.00	0.00
0.94	0.00	0.00	0.00	0.00	0.00	0.00
0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.10	0.00	0.00	0.00	0.00	0.00	0.00
					Average of	1.13E-05

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: BerryD15
Metfile: w23234.dvf
PRZM scei CAWineGrapes no_irrig.txt
EXAMS en pond298.exv
Chemical N Chloropicrin

Descriptior	Variable Na	Value	Units	Comments
Molecular v	mwt	164.4	g/mol	
Henry's La	henry	0.00205	atm-m^3/mol	
Vapor Pres	vapr	23.8	torr	
Solubility	sol	1621	mg/L	
Kd	Kd		mg/L	
Koc	Koc	36.05	mg/L	
Photolysis	kdp	1.3	days	Half-life
Aerobic Aq	kbacw	31.42	days	Halfife
Anaerobic .	kbacs	0.05	days	Halfife
Aerobic So	asm	15.71	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	8	integer	See PRZM manual
Incorporati	DEPI	76.2	cm	
Application	TAPP	560	kg/ha	
Application	APPEFF	1	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond	
Application	Date	15-12	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0		
Flag for Inc	IR	Pond		
Flag for rur	RUNOFF	none	none, monthly or total(average of entire run)	

Drip Irrigation

stored as CAM8_IRI.out

Chemical: Chloropicrin

PRZM envir	modified Friday, 8 June 2007 at 20:04:29
EXAMS env	modified Thuday, 29 August 2002 at 16:33:30
Metfile: w23	modified Wedday, 3 July 2002 at 10:04:22

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.00	0.00	0.00	0.00	0.00	0.00
1962	4.55	3.86	1.74	0.61	0.41	0.17
1963	2.65	2.07	0.99	0.48	0.33	0.08
1964	45.22	37.61	16.02	5.61	3.74	1.00
1965	31.33	27.04	9.21	3.64	2.43	1.02
1966	23.16	19.33	10.01	4.05	2.70	0.67
1967	7.41	5.84	2.39	0.84	0.56	0.25
1968	28.77	22.32	6.27	2.19	1.46	0.48
1969	63.13	48.86	20.56	7.19	4.80	1.55
1970	22.09	17.43	8.61	3.01	2.01	0.93
1971	20.30	15.84	5.45	1.91	1.27	0.54
1972	9.68	8.03	3.44	1.23	0.82	0.40
1973	39.83	31.84	12.88	4.51	3.01	0.96
1974	21.13	17.89	8.87	3.37	2.25	0.60
1975	2.46	1.93	0.88	0.55	0.37	0.09
1976	18.69	8.54	1.63	0.57	0.38	0.10
1977	29.36	23.08	11.23	3.93	2.62	1.24
1978	16.63	13.78	8.80	3.67	2.46	0.62
1979	72.26	57.56	19.33	6.77	4.51	1.30
1980	28.23	22.26	12.49	5.02	3.36	0.83
1981	40.88	31.41	12.73	4.46	2.97	0.80
1982	95.95	74.12	27.94	9.78	6.52	2.58
1983	68.42	56.38	17.09	5.98	3.99	1.64
1984	24.94	19.65	8.82	3.32	2.22	0.55
1985	0.65	0.50	0.21	0.08	0.06	0.02
1986	22.48	18.03	7.55	2.64	1.76	0.60
1987	11.66	9.12	4.36	1.72	1.15	0.30
1988	41.51	32.42	12.98	4.54	3.03	0.91
1989	14.71	11.65	5.51	2.14	1.43	0.35
1990	1.89	1.49	0.71	0.30	0.20	0.05

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	95.95	74.12	27.94	9.78	6.52	2.58
0.06	72.26	57.56	20.56	7.19	4.80	1.64
0.10	68.42	56.38	19.33	6.77	4.51	1.55
0.13	63.13	48.86	17.09	5.98	3.99	1.30
0.16	45.22	37.61	16.02	5.61	3.74	1.24
0.19	41.51	32.42	12.98	5.02	3.36	1.02
0.23	40.88	31.84	12.88	4.54	3.03	1.00
0.26	39.83	31.41	12.73	4.51	3.01	0.96
0.29	31.33	27.04	12.49	4.46	2.97	0.93
0.32	29.36	23.08	11.23	4.05	2.70	0.91
0.35	28.77	22.32	10.01	3.93	2.62	0.83
0.39	28.23	22.26	9.21	3.67	2.46	0.80
0.42	24.94	19.65	8.87	3.64	2.43	0.67
0.45	23.16	19.33	8.82	3.37	2.25	0.62
0.48	22.48	18.03	8.80	3.32	2.22	0.60
0.52	22.09	17.89	8.61	3.01	2.01	0.60
0.55	21.13	17.43	7.55	2.64	1.76	0.55
0.58	20.30	15.84	6.27	2.19	1.46	0.54
0.61	18.69	13.78	5.51	2.14	1.43	0.48
0.65	16.63	11.65	5.45	1.91	1.27	0.40
0.68	14.71	9.12	4.36	1.72	1.15	0.35
0.71	11.66	8.54	3.44	1.23	0.82	0.30
0.74	9.68	8.03	2.39	0.84	0.56	0.25
0.77	7.41	5.84	1.74	0.61	0.41	0.17
0.81	4.55	3.86	1.63	0.57	0.38	0.10
0.84	2.65	2.07	0.99	0.55	0.37	0.09
0.87	2.46	1.93	0.88	0.48	0.33	0.08
0.90	1.89	1.49	0.71	0.30	0.20	0.05
0.94	0.65	0.50	0.21	0.08	0.06	0.02
0.97	0.00	0.00	0.00	0.00	0.00	0.00
0.10	67.89	55.63	19.11	6.69	4.46	1.52
					Average of	0.69

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:

Output File:	CAM8_IRI			
Metfile:	w23234.dvf			
PRZM scen	CAStrawberry-noplastic_irrig.txt			
EXAMS env	pond298.exv			
Chemical Na	Chloropicrin			
Description	Variable Nam	Value	Units	Comments
Molecular w	mwt	164.4	g/mol	
Henry's Law	henry	0.00205	atm-m^3/mol	
Vapor Press	vapr	23.8	torr	
Solubility	sol	1621	mg/L	
Kd	Kd		mg/L	
Koc	Koc	36.05	mg/L	
Photolysis h	kdp	1.3	days	Half-life
Aerobic Aq	kbacw	31.42	days	Halfife
Anaerobic A	kbacs	0.05	days	Halfife
Aerobic Soi	asm	15.71	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	8	integer	See PRZM manual
Incorporatio	DEPI	25	cm	
Application	TAPP	336	kg/ha	
Application	APPEFF	1	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond	
Application	Date	15-12	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0		
Flag for Ind	IR	EPA Pond		
Flag for run	RUNOFF	none	none, monthly or total(average of entire run)	

Drip Irrigation

stored as PotatoIR.out

Chemical: Chloropicrin

PRZM envi modified Thuday, 14 June 2007 at 10:43:27

EXAMS env modified Thuday, 29 August 2002 at 16:33:30

Metfile: w23 modified Wedday, 3 July 2002 at 10:04:20

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.22	0.17	0.10	0.04	0.02	0.01
1962	0.48	0.38	0.17	0.06	0.04	0.01
1963	0.54	0.42	0.24	0.09	0.06	0.02
1964	0.27	0.21	0.11	0.04	0.03	0.01
1965	0.17	0.13	0.07	0.03	0.02	0.01
1966	0.38	0.30	0.14	0.05	0.03	0.01
1967	0.42	0.37	0.21	0.08	0.05	0.01
1968	0.18	0.14	0.06	0.02	0.02	0.00
1969	0.36	0.31	0.15	0.06	0.04	0.01
1970	0.30	0.24	0.12	0.04	0.03	0.01
1971	0.36	0.30	0.16	0.06	0.04	0.01
1972	0.14	0.11	0.06	0.02	0.01	0.00
1973	0.39	0.33	0.19	0.07	0.05	0.01
1974	0.15	0.12	0.07	0.03	0.02	0.00
1975	0.60	0.50	0.28	0.11	0.07	0.02
1976	0.19	0.17	0.09	0.03	0.02	0.01
1977	0.30	0.23	0.12	0.05	0.03	0.01
1978	0.33	0.28	0.17	0.06	0.04	0.01
1979	0.23	0.18	0.10	0.04	0.03	0.01
1980	0.24	0.19	0.10	0.04	0.03	0.01
1981	0.56	0.50	0.31	0.12	0.08	0.02
1982	0.10	0.08	0.04	0.02	0.01	0.00
1983	0.54	0.42	0.27	0.11	0.07	0.02
1984	0.18	0.15	0.07	0.03	0.02	0.00
1985	0.30	0.26	0.15	0.06	0.04	0.01
1986	0.57	0.45	0.25	0.10	0.06	0.02
1987	0.66	0.53	0.30	0.11	0.08	0.02
1988	0.30	0.23	0.11	0.04	0.03	0.01
1989	0.48	0.39	0.18	0.06	0.04	0.01
1990	0.08	0.06	0.02	0.01	0.01	0.00

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.03	0.66	0.53	0.31	0.12	0.08	0.02
0.06	0.60	0.50	0.30	0.11	0.08	0.02
0.10	0.57	0.50	0.28	0.11	0.07	0.02
0.13	0.56	0.45	0.27	0.11	0.07	0.02
0.16	0.54	0.42	0.25	0.10	0.06	0.02
0.19	0.54	0.42	0.24	0.09	0.06	0.02
0.23	0.48	0.39	0.21	0.08	0.05	0.01
0.26	0.48	0.38	0.19	0.07	0.05	0.01
0.29	0.42	0.37	0.18	0.06	0.04	0.01
0.32	0.39	0.33	0.17	0.06	0.04	0.01
0.35	0.38	0.31	0.17	0.06	0.04	0.01
0.39	0.36	0.30	0.16	0.06	0.04	0.01
0.42	0.36	0.30	0.15	0.06	0.04	0.01
0.45	0.33	0.28	0.15	0.06	0.04	0.01
0.48	0.30	0.26	0.14	0.05	0.03	0.01
0.52	0.30	0.24	0.12	0.05	0.03	0.01
0.55	0.30	0.23	0.12	0.04	0.03	0.01
0.58	0.30	0.23	0.11	0.04	0.03	0.01
0.61	0.27	0.21	0.11	0.04	0.03	0.01
0.65	0.24	0.19	0.10	0.04	0.03	0.01
0.68	0.23	0.18	0.10	0.04	0.03	0.01
0.71	0.22	0.17	0.10	0.04	0.02	0.01
0.74	0.19	0.17	0.09	0.03	0.02	0.01
0.77	0.18	0.15	0.07	0.03	0.02	0.01
0.81	0.18	0.14	0.07	0.03	0.02	0.00
0.84	0.17	0.13	0.07	0.03	0.02	0.00
0.87	0.15	0.12	0.06	0.02	0.02	0.00
0.90	0.14	0.11	0.06	0.02	0.01	0.00
0.94	0.10	0.08	0.04	0.02	0.01	0.00
0.97	0.08	0.06	0.02	0.01	0.01	0.00
0.10	0.57	0.49	0.28	0.11	0.07	0.02
					Average of :	0.01

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:

Output File:	PotatoIR			
Metfile:	w23155.dvf			
PRZM scen	CAPotato_Wirrig_FK.txt			
EXAMS env	pond298.exv			
Chemical Na	Chloropicrin			
Description	Variable Nar	Value	Units	Comments
Molecular w	mwt	164.4	g/mol	
Henry's Law	henry	0.00205	atm-m^3/mol	
Vapor Press	vapr	23.8	torr	
Solubility	sol	1621	mg/L	
Kd	Kd		mg/L	
Koc	Koc	36.05	mg/L	
Photolysis h	kdp	1.3	days	Half-life
Aerobic Aq	kbacw	31.42	days	Halfife
Anaerobic A	kbacs	0.05	days	Halfife
Aerobic Soi	asm	15.71	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	8	integer	See PRZM manual
Incorporatio	DEPI	25	cm	
Application	TAPP	336	kg/ha	
Application	APPEFF	1	fraction	
Spray Drift	DRFT	0	fraction of application rate applied to pond	
Application	Date	2-Jan	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0		
Flag for Ind	IR	EPA Pond		
Flag for run	RUNOFF	none	none, monthly or total(average of entire run)	

Appendix B Terrestrial Exposure Modeling-PERFUM

** PERFUM Output File
****

Version 2.1.3 - compiled on 12/11/2006
Run finished on: 03/16/2007 at 00:18

****
** Basic information about the model run
****
Scenario Type: SF

Source of flux data: CDPR Commodity Permit Conditions
Source of meteorological data:
Bakersfield, CA
Venture, CA
Field size (acres): 39.976
Length in x-direction (m): 402.30
Length in y-direction (m): 402.30
Grid density: FINE

****
** Exposure Assumptions
****

Exposure averaging period (hours): 4
Distribution averaging time (hours): 4

--------- PERFUM Model Results -----------

Concentration distribution results for rings
the field

Ring No.	Distance (meters)
1	5.
2	7.
3	10.
4	15.
5	20.
6	30.
7	50.

8	70.
9	80.
10	90.
11	100.
12	120.
13	150.
14	180.
15	210.

Bakerfields: 40 acre bedded tarped @ 350lbs a.i./acre

Days	Periods	%tile	Ring1	Ring2	Ring3	Ring4	Ring5	Ring6	Ring7	Ring8	Ri
Day1	Period 1	90	583	583	573	554	544	505	446	387	3
	Period 2	90	985	975	965	936	907	858	750	671	6
	Period 3	90	1254	1254	1235	1191	1152	1073	916	799	7
	Period 4	90	1063	1044	1005	936	887	779	632	534	4
	Period 5	90	946	926	877	809	760	662	544	456	4
	Period 6	90	1744	1725	1686	1607	1548	1411	1201	1034	9
Day 2	Period 1	90	2920	2920	2881	2803	2724	2548	2234	1960	18
	Period 2	90	1764	1744	1725	1686	1627	1548	1352	1181	11
	Period 3	90	1201	1191	1171	1132	1093	1014	877	779	7
	Period 4	90	632	613	593	554	524	466	368	309	2
	Period 5	90	279	270	250	230	221	191	152	132	1
	Period 6	90	319	309	299	289	279	250	211	181	1

Bakerfields: 40 acre bedded untarped @ 175 lbs a.i./acre

Days	Periods	%tile	Ring1	Ring2	Ring3	Ring4	Ring5	Ring6	Ring7	Ring8	Ri
Day1	Period 1	90	1548.4	1528.8	1470	1391.6	1313.2	1190.7	984.9	837.9	77
	Period 2	90	2802.8	2783.2	2744	2685.2	2606.8	2430.4	2116.8	1881.6	17
	Period 3	90	2175.6	2156	2136.4	2097.2	2038.4	1901.2	1666	1470	139
	Period 4	90	994.7	994.7	975.1	945.7	916.3	857.5	739.9	651.7	61
	Period 5	90	367.5	357.7	347.9	328.3	318.5	279.3	230.3	191.1	18
	Period 6	90	151.9	142.1	132.3	122.5	112.7	102.9	83.3	63.7	6
Day 2	Period 1	90	122.5	122.5	122.5	112.7	102.9	93.1	73.5	63.7	6
	Period 2	90	200.9	200.9	200.9	200.9	191.1	181.3	151.9	132.3	13
	Period 3	90	200.9	200.9	200.9	191.1	181.3	171.5	151.9	132.3	13
	Period 4	90	171.5	171.5	171.5	161.7	161.7	151.9	132.3	112.7	10
	Period 5	90	44.1	44.1	44.1	44.1	34.3	34.3	24.5	24.5	24
	Period 6	90	24.5	14.7	14.7	14.7	14.7	14.7	14.7	4.9	4

Days	Periods	%tile	Ring1	Ring2	Ring3	Ring4	Ring5	Ring6	Ring7	Ring8
Day1	Period 1	90	417	407	397	368	348	309	250	211
	Period 2	90	3156	3156	3116	3038	2940	2744	2372	2078
	Period 3	90	3626	3606	3567	3469	3371	3175	2822	2509
	Period 4	90	1548	1529	1509	1470	1431	1333	1161	1014
	Period 5	90	956	946	926	887	848	779	652	564
	Period 6	90	407	397	377	348	319	279	221	181
Day 2	Period 1	90	397	387	368	348	328	289	240	201
	Period 2	90	1122	1122	1103	1073	1034	975	838	730
	Period 3	90	1274	1254	1235	1210	1181	1103	975	877
	Period 4	90	858	848	838	809	789	740	642	564
	Period 5	90	436	426	417	397	377	348	299	250
	Period 6	90	142	142	132	123	113	93	74	64

Bakerfields: 40 acre Broadcast tarped @ 350 lbs a.i./acre

Days	Periods	%tile	Ring1	Ring2	Ring3	Ring4	Ring5	Ring6	Ring7	Ring8
Day1	Period 1	90	534	524	495	466	436	387	319	270
	Period 2	90	622	613	593	573	544	495	417	358
	Period 3	90	466	466	456	446	436	407	358	309
	Period 4	90	740	740	730	711	691	642	554	485
	Period 5	90	2528	2509	2450	2352	2234	2038	1686	1431
	Period 6	90	2117	2058	1960	1803	1686	1490	1191	1005
Day 2	Period 1	90	1568	1529	1450	1352	1274	1122	926	789
	Period 2	90	1588	1568	1529	1450	1372	1254	1054	907
	Period 3	90	720	720	711	691	671	632	544	485
	Period 4	90	720	720	711	691	671	632	544	475
	Period 5	90	1705	1686	1646	1568	1490	1372	1152	975
	Period 6	90	1352	1313	1235	1152	1073	946	760	632

Bakerfields: 40 acre Drip tarped @ 300 lbs a.i./acre										
Days	**Periods**	**%tile**	**Ring1**	**Ring2**	**Ring3**	**Ring4**	**Ring5**	**Ring6**	**Ring7**	**Ring8**
Day1	Period 1	90	221	211	201	191	181	162	123	103
	Period 2	90	289	289	270	250	230	211	172	142
	Period 3	90	701	691	681	652	622	564	475	417
	Period 4	90	83	83	83	83	74	74	64	54
	Period 5	90	93	83	83	83	83	74	64	54
	Period 6	90	83	83	83	83	74	74	64	54
Day 2	Period 1	90	74	74	74	64	64	54	44	34
	Period 2	90	83	83	83	74	74	64	54	44
	Period 3	90	201	201	191	191	181	162	142	123
	Period 4	90	5	5	5	5	5	5	5	5
	Period 5	90	5	5	5	5	5	5	5	5
	Period 6	90	5	5	5	5	5	5	5	5

Salinas Bakerfields: 40 acre Drip tarped @ 300 lbs a.i./acre										
Days	**Periods**	**%tile**	**Ring1**	**Ring2**	**Ring3**	**Ring4**	**Ring5**	**Ring6**	**Ring7**	**Ring8**
Day1	Period 1	90	309	299	289	270	250	221	181	152
	Period 2	90	573	554	534	495	456	397	328	270
	Period 3	90	319	319	309	299	279	260	221	191
	Period 4	90	123	123	123	113	113	103	93	83
	Period 5	90	113	113	103	103	103	93	83	74
	Period 6	90	54	54	54	54	54	44	44	34
Day 2	Period 1	90	83	74	74	74	64	54	44	34
	Period 2	90	93	93	83	74	74	64	54	44
	Period 3	90	74	74	74	74	64	64	54	44
	Period 4	90	44	44	44	44	44	34	34	25
	Period 5	90	15	15	15	15	15	15	15	15
	Period 6	90	15	15	15	15	15	15	15	5

Ventura: 40 acre bedded tarped @ 350lbs a.i./acre

Days	Periods	%tile	Ring1	Ring2	Ring3	Ring4	Ring5	Ring6	Ring7	Ring8
Day1	Period 1	90	632	622	613	583	564	524	456	407
	Period 2	90	1103	1093	1073	1034	1005	936	838	750
	Period 3	90	1372	1352	1333	1274	1220	1132	975	858
	Period 4	90	1054	1024	985	926	867	769	632	534
	Period 5	90	828	809	779	740	691	622	515	446
	Period 6	90	1509	1470	1431	1352	1274	1142	936	799
Day 2	Period 1	90	3195	3156	3077	2960	2842	2626	2313	2058
	Period 2	90	1940	1921	1882	1823	1764	1666	1431	1254
	Period 3	90	1274	1254	1235	1171	1122	1054	926	818
	Period 4	90	622	603	583	544	505	456	368	309
	Period 5	90	240	240	230	221	201	181	152	132
	Period 6	90	270	260	250	240	221	201	162	132

Ventura: 40 acre bedded untarped @ 175 lbs a.i./acre

Days	Periods	%tile	Ring1	Ring2	Ring3	Ring4	Ring5	Ring6	Ring7	Ring8
Day1	Period 1	90	1235	1220	1161	1093	1024	916	750	642
	Period 2	90	2881	2862	2803	2685	2587	2411	2078	1803
	Period 3	90	2470	2450	2411	2332	2254	2097	1803	1588
	Period 4	90	1073	1054	1034	985	946	877	769	691
	Period 5	90	368	368	348	328	309	279	240	201
	Period 6	90	132	132	123	113	113	93	83	64
Day 2	Period 1	90	103	93	93	83	83	74	64	54
	Period 2	90	211	211	201	201	191	172	152	132
	Period 3	90	230	221	221	211	201	191	172	152
	Period 4	90	181	181	181	172	162	152	132	123
	Period 5	90	44	44	44	44	34	34	25	25
	Period 6	90	5	5	5	5	5	5	5	5

Ventura: 40 acre Broadcast tarped @ 350 lbs a.i./acre

Days	Periods	%tile	Ring1	Ring2	Ring3	Ring4	Ring5	Ring6	Ring7	Ring8
Day1	Period 1	90	456	446	426	407	387	338	289	250
	Period 2	90	564	554	534	505	475	426	358	299
	Period 3	90	534	524	515	495	475	436	387	348
	Period 4	90	818	809	799	769	740	681	593	534
	Period 5	90	2764	2724	2666	2548	2411	2195	1842	1588
	Period 6	90	2019	1960	1882	1744	1627	1450	1181	1005
Day 2	Period 1	90	1333	1313	1254	1191	1122	1005	838	730
	Period 2	90	1411	1372	1333	1254	1181	1054	858	730
	Period 3	90	828	818	799	769	730	681	593	534
	Period 4	90	809	799	779	760	720	671	583	524
	Period 5	90	1842	1823	1784	1705	1627	1470	1235	1073
	Period 6	90	1294	1254	1191	1112	1044	916	750	642

Ventura: 40 acre Broadcast untarped @ 175 lbs a.i./acre

Days	Periods	%tile	Ring1	Ring2	Ring3	Ring4	Ring5	Ring6	Ring7	Ring8
Day1	Period 1	90	338	328	319	299	279	250	211	181
	Period 2	90	3175	3136	3077	2979	2842	2607	2215	1901
	Period 3	90	4219	4190	4072	3954	3837	3665	3293	2960
	Period 4	90	1705	1686	1646	1588	1529	1392	1220	1093
	Period 5	90	985	965	936	897	848	769	652	564
	Period 6	90	377	368	348	328	309	270	221	191
Day 2	Period 1	90	319	309	299	279	270	240	201	172
	Period 2	90	1122	1112	1093	1044	1005	916	779	671
	Period 3	90	1490	1470	1450	1392	1352	1274	1132	1014
	Period 4	90	946	936	916	877	848	779	671	603
	Period 5	90	436	426	417	387	368	338	279	240
	Period 6	90	132	123	123	113	103	93	74	64

Ventura: 40 acre Drip tarped @ 300 lbs a.i./acre

Days	Periods	%tile	Ring1	Ring2	Ring3	Ring4	Ring5	Ring6	Ring7	Ring8
Day1	Period 1	90	211	211	201	191	172	152	123	103
	Period 2	90	250	240	230	221	211	181	152	132
	Period 3	90	603	593	573	544	505	456	377	319
	Period 4	90	93	93	83	83	83	74	64	54
	Period 5	90	103	103	93	93	93	83	74	64
	Period 6	90	93	83	83	83	83	74	64	54
Day 2	Period 1	90	74	74	74	64	64	54	44	34
	Period 2	90	74	74	74	64	64	54	44	34
	Period 3	90	172	172	162	152	142	132	103	93
	Period 4	90	5	5	5	5	5	5	5	5
	Period 5	90	15	15	15	15	5	5	5	5
	Period 6	90	5	5	5	5	5	5	5	5

Ventura (Salinas) : 40 acre Drip tarped @ 300 lbs a.i./acre

Days	Periods	%tile	Ring1	Ring2	Ring3	Ring4	Ring5	Ring6	Ring7	Ring8
Day1	Period 1	90	309	299	289	270	250	221	181	152
	Period 2	90	505	495	475	446	426	377	319	270
	Period 3	90	279	270	260	250	230	211	172	142
	Period 4	90	132	132	132	123	123	113	93	83
	Period 5	90	123	123	123	113	113	103	93	83
	Period 6	90	54	54	54	54	54	44	44	34
Day 2	Period 1	90	83	74	74	74	64	54	44	34
	Period 2	90	83	83	74	74	64	54	44	44
	Period 3	90	64	64	64	54	54	44	34	34
	Period 4	90	44	44	44	44	44	44	34	25
	Period 5	90	15	15	15	15	15	15	15	15
	Period 6	90	15	15	15	15	15	15	15	15

Appendix C. The Risk Quotient Method and Levels of Concern

Risk characterization integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects. The means of this integration is called the quotient method. Risk quotients (RQs) are calculated by dividing exposure estimates by acute and chronic ecotoxicity values.

RQ = EXPOSURE/TOXICITY

RQs are then compared to OPP's levels of concern (LOCs). These LOCs are used by OPP to analyze potential risk to nontarget organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories: (1) acute risks - regulatory action may be warranted in addition to restricted use classification, (2) acute restricted use - the potential for acute risk is high, but may be mitigated through restricted use classification, (3) acute endangered species - endangered species may be adversely affected, and (4) chronic risk - the potential for chronic risk is high regulatory action may be warranted.   Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to insects, or chronic risk from granular/bait formulations to birds or mammals.

The ecotoxicity test values (measurement endpoints) used in the acute and chronic risk quotients are derived from required studies. Examples of ecotoxicity values derived from short-term laboratory studies that assess acute effects are: (1) LC_{50} (fish and birds), (2) LD_{50} (birds and mammals), (3) EC_{50} (aquatic plants and aquatic invertebrates) and (4) EC_{25} (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic effects are: (1) LOAEL or LOAEC (birds, fish, and aquatic invertebrates) and (2) NOAEL or NOAEC (birds, fish and aquatic invertebrates). For birds, mammals, fish and aquatic invertebrates the NOAEL or NOAEC generally is used as the ecotoxicity test value in assessing chronic effects, although other values may be used when justified. Risk presumptions and the corresponding RQs and LOCs, are tabulated below.

Table 1. Risk presumptions for terrestrial animals based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
	Birds	
Acute Risk	EEC[1]/LC_{50} or LD_{50}/ft^2 or LD_{50}/day[3]	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
	Wild Mammals	
Acute Risk	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1

[1] abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items
[2] mg/ft^2
[3] mg of toxicant consumed/day
LD_{50} * wt. of bird
LD_{50} * wt. of bird

Table 2. Risk presumptions for aquatic animals based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
Acute Risk	EEC[1]/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Endangered Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/NOAEC	1

[1] EEC = (ppm or ppb) in water

Table 3. Risk presumptions for plants based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
	Terrestrial and Semi-Aquatic Plants	
Acute Risk	EEC[1]/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOAEC	1
	Aquatic Plants	
Acute Risk	EEC[2]/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOAEC	1

[1] EEC = lbs ai/A
[2] EEC = (ppb/ppm) in water

Appendix D: Bibliography of ECOTOX Open Literature Not Used Quantitatively or Qualitatively

Explanation of OPP Acceptability Criteria and Rejection Codes for ECOTOX Data

Studies located and coded into ECOTOX must meet acceptability criteria, as established in the *Interim Guidance of the Evaluation Criteria for Ecological Toxicity Data in the Open Literature, Phase I and II*, Office of Pesticide Programs, U.S. Environmental Protection Agency, July 16, 2004. Studies that do not meet these criteria are designated in the bibliography as "Accepted for ECOTOX but not OPP." The intent of the acceptability criteria is to ensure data quality and verifiability. The criteria parallel criteria used in evaluating registrant-submitted studies. Specific criteria are listed below, along with the corresponding rejection code.

- The paper does not report toxicology information for a chemical of concern to OPP; (Rejection Code: NO COC)
- The article is not published in English language; (Rejection Code: NO FOREIGN)
- The study is not presented as a full article. Abstracts will not be considered; (Rejection Code: NO ABSTRACT)
- The paper is not publicly available document; (Rejection Code: NO NOT PUBLIC (typically not used, as any paper acquired from the ECOTOX holding or through the literature search is considered public)
- The paper is not the primary source of the data; (Rejection Code: NO REVIEW)
- The paper does not report that treatment(s) were compared to an acceptable control; (Rejection Code: NO CONTROL)
- The paper does not report an explicit duration of exposure; (Rejection Code: NO DURATION)
- The paper does not report a concurrent environmental chemical concentration/dose or application rate; (Rejection Code: NO CONC)
- The paper does not report the location of the study (e.g., laboratory vs. field); (Rejection Code: NO LOCATION)
- The paper does not report a biological effect on live, whole organisms; (Rejection Code: NO IN-VITRO)
- The paper does not report the species that was tested; and this species can be verified in a reliable source; (Rejection Code: NO SPECIES)
- The paper does not report effects associated with exposure to a single chemical. (Rejection Code: NO MIXTURE)

Additionally, efficacy studies on target species are excluded and coded as NO TARGET.

Data that originated from the OPP Pesticide Ecotoxicity Database is coded as NO EFED. These data are already available to the chemical team.

Bibliographic citations listed as "Acceptable for ECOTOX and OPP" listed in this Appendix have brief explanations as to why the study was not selected for use in the assessment. Those that were used in the assessment are included in the main body of the report.

CHLOROPICRIN (Refresh May 2005 - March 2007)
Papers that Were Accepted for ECOTOX

Acceptable for ECOTOX and OPP

Ajwa, H. A. and Trout, T. (2004). Drip Application of Alternative Fumigants to Methyl Bromide for Strawberry Production. *Hortscience* 39: 1707-1715.

EcoReference No.: 89252
Chemical of Concern: MB,CLP,MTAS; Habitat: T; Effect Codes: POP,GRO; Rejection Code: efficacy/not a selected endpoint

Allen, M. W. (1946). Control of Root-Knot Nematode with D-D Mixture and Chloropicrin. *Calif.Agric.Exp.Stn.Circ.* 365: 62-65.

EcoReference No.: 89318
Chemical of Concern: CLP,DPDP; Habitat: T; Effect Codes: POP; Rejection Code: efficacy/not a selected endpoint

Browne, G. T., Connell, J. H., and Schneider, S. M. (2006). Almond Replant Disease and Its Management With Alternative Pre-Plant Soil Fumigation Treatments and Rootstocks. *Plant Dis.* 90: 869-876.

EcoReference No.: 89589
Chemical of Concern: MB,CLP,DPDP,IDM; Habitat: T; Effect Codes: GRO,POP; Rejection Code: efficacy/not a selected endpoint

Condie, L. W., Daniel, F. B., Olson, G. R., and Robinson, M. (1994). Ten and Ninety-Day Toxicity Studies of Chloropicrin in Sprague-Dawley Rats. *Drug Chem.Toxicol.* 17: 125-137.

EcoReference No.: 89755
Chemical of Concern: CLP; Habitat: T; Effect Codes: CEL,PHY,BEH,MOR,GRO,BCM; Rejection Code: HED-type study/not a selected endpoint

Coosemans, J. (1974). Possibilities and Some Particular Requirements in Cut-Flower Soil Disinfestation.

Agric.Environ. 1: 243-250.

EcoReference No.: 80364
Chemical of Concern: CLP,MB,DZM; Habitat: T; Effect Codes: GRO,PHY,POP; Rejection Code: efficacy/not a selected endpoint

Darby, J. F., Dieter, C. E., and Rau, G. J. (1962). Evaluation of Treatments for Control of Soil-Borne Pests in Celery Seedbeds. *Plant Dis.Rep.* 46: 441-443.

EcoReference No.: 89323
Chemical of Concern: MB,CLP,EDB,DPDP,Urea,FML,DZM,MTAS; Habitat: T; Effect Codes: POP; Rejection Code: efficacy/not a selected endpoint

Gerik, J. S. (2005). Evaluation of Soil Fumigants Applied by Drip Irrigation for Liatris Production. *Plant Dis.* 89: 883-887.

EcoReference No.: 89504
Chemical of Concern: CLP,NaN3,MTAS,FUR,ASCN,CH3I,DPDP; Habitat: T; Effect Codes: POP,PHY; Rejection Code: efficacy/not a selected endpoint

Gerik, J. S., Greene, I. D., Beckman, P., and Elmore, C. L. (2006). Preplant Drip-Applied Fumigation for Calla Lily Rhizome Nursery. *Horttechnology* 16: 297-300 .

EcoReference No.: 89233
Chemical of Concern: CH3I,CLP,DPDP,MTM,FUR,NaN3; Habitat: T; Effect Codes: MOR,GRO; Rejection Code: efficacy/not a selected endpoint

Goodell, B. S., Helsing, G. G., and Graham, R. D. (1984). Responses of Douglas-Fir Trees to Injection of Chloropicrin. *Can.J.For.Res.* 14: 623-627.

EcoReference No.: 89220
Chemical of Concern: CLP; Habitat: T; Effect Codes: PHY,GRO; Rejection Code: efficacy/not a selected endpoint

Gur, A., Cohen, Y., Katan, J., and Barkai, Z. (1991). Preplant Application of Soil Fumigants and Solarization for Treating Replant Diseases of Peaches and Apples. *Sci.Hortic.* 45: 215-224.

EcoReference No.: 89622
Chemical of Concern: MITC,EDB,DPDP,MB,CLP; Habitat: T; Effect Codes: POP,GRO; Rejection Code: efficacy/not a selected endpoint

Jaworski, C. A., McCarter, S. M., Johnson, A. W., and Williamson, R. E. (1978). Response of Onions Grown for Transplants to Soil Fumigation. *J.Am.Soc.Hortic.Sci.* 103: 385-388.

EcoReference No.: 89238
Chemical of Concern: MB,CLP,NaDC,DPDP; Habitat: T; Effect Codes: POP; Rejection Code: efficacy/not a selected endpoint

Jones, J. P., Overman, A. J., and Geraldson, C. M. (1971). Fumigants for the Control of Verticillium Wilt of Tomato. *Plant Dis.Rep.* 55: 26-30.

EcoReference No.: 89320
Chemical of Concern: EDB,MITC,CLP,DPDP,BMY; Habitat: T; Effect Codes: POP; Rejection

Code: efficacy/not a selected endpoint

Kulkarni, J. H., Sardeshpande, J. S., and Bagyaraj, D. J. (1975). Effect of Seed Fumigation on the Symbiosis of Rhizobium sp. with Arachis hypogaea Linn. *In: Zentralbl.Bakteriol.Parasitenkd.Infektionskr.Hyg., Abt.2, Naturwissenschaftliche, Allg.Landwirtschaft.Tech.Mikrobiol.* 130: 41-44.

EcoReference No.: 89474
Chemical of Concern: EDB,MLN,PPHN,CLP; Habitat: T; Effect Codes: REP,GRO,POP,BCM; Rejection Code: efficacy/not a selected endpoint (not on ECOTOX tables)

Medina, J. J., Miranda, L., Romero, F., De los Santos, B., Montes, F., Vega, J. M., Paez, J. I., Bascon, J., and Lopez-Aranda, J. M. (2004). Six-Year Work on Alternatives to Methyl Bromide (MB) for Strawberry Production in Huelva (Spain). *Acta Hortic.* 649: 251-254.

EcoReference No.: 79934
Chemical of Concern: CLP,MB,DZM,DMDS; Habitat: T; Effect Codes: POP; Rejection Code: efficacy/not a selected endpoint

Park, D.-S., Peterson, C., Zhao, S., and Coats, J. R. (2004). Fumigation Toxicity of Volatile Natural and Synthetic Cyanohydrins to Stored-Product Pests and Activity as Soil Fumigants. *Pest Manag.Sci.* 60: 833-838.

EcoReference No.: 86819
Chemical of Concern: DPDP,MB,DDVP,CLP; Habitat: T; Effect Codes: MOR,REP,POP,SYS; Rejection Code: efficacy/not a selected endpoint

Slykhuis, J. T. and Li, T. S. C. (1985). Responses of Apple Seedlings to Biocides and Phosphate Fertilizers in Orchard Soils in British Columbia. *Can.J.Plant Pathol.* 7: 294-301.

EcoReference No.: 79915
Chemical of Concern: FSTAl,MZB,BMY,PNB,MLX,MB,FML,CLP,Captan,DZM; Habitat: T; Effect Codes: GRO,MOR; Rejection Code: efficacy/not a selected endpoint

Tam, R. K. (1945). The Comparative Effects of a 50-50 Mixture of 1:3-Dichloropropene and 1:2-Dichloropropane (D-D Mixture) and of Chloropicrin on Nitrification in Soil and on the Growth of the Pineapple Plant. *Soil Sci.* 59: 191-205.

EcoReference No.: 89200
Chemical of Concern: CLP,DPDP; Habitat: T; Effect Codes: GRO,BCM; Rejection Code: efficacy/not a selected endpoint

Thies, W. G. and Nelson, E. E. (1996). Reducing Phellinus weirii Inoculum by Applying Fumigants to Living Douglas-Fir. *Can.J.For.Res.* 26: 1158-1165.

EcoReference No.: 89235
Chemical of Concern: CLP,MITC; Habitat: T; Effect Codes: MOR,GRO,POP; Rejection Code: efficacy/not a selected endpoint

Townshend, J. L., Ricketson, C. L., and Wiebe, J. (1966). The Effect of Spring Application of Nematocides on Strawberry in the Niagara Peninsula. *Can.J.Plant Sci.* 46: 111-114.

EcoReference No.: 89467
Chemical of Concern: MITC,CLP,DPDP; Habitat: T; Effect Codes: POP; Rejection Code:

efficacy/not a selected endpoint

Tsror, L., Erlich, O., Cahlon, Y., Hadar, A., Cohen, Y., Klein, L., Peretz-Alon, I., and Negev, M. P. (2000). Control of Verticillium dahliae Prior to Potato Production by Soil Fumigation with Chloropicrin. *Acta Hortic.* 532: 201-204.

EcoReference No.: 89305
Chemical of Concern: CLP,MB; Habitat: T; Effect Codes: GRO,POP; Rejection Code: efficacy/not a selected endpoint

Whitehead, A. G., Fraser, J. E., and Greet, D. N. (1970). The Effect of D-D, Chloropicrin and Previous Crops on Numbers of Migratory Root-Parasitic Nematodes and on the Growth of Sugar Beet and Barley. *Ann.Appl.Biol.* 65: 351-359.

EcoReference No.: 89202
Chemical of Concern: CLP,DPDP; Habitat: T; Effect Codes: POP,BCM,GRO; Rejection Code: efficacy/not a selected endpoint

Acceptable for ECOTOX but not OPP

Moldenke, A. R. and Thies, W. G. (1996). Effect on Soil Arthropods 1 Year After Application of Chloropicrin to Control Laminated Root Rot. III. Treatment Effects on Nontarget Soil Invertebrates. *Can.J.For.Res.* 26: 120-127.

EcoReference No.: 89231
Chemical of Concern: CLP; Habitat: T; Effect Codes: POP; Rejection Code: OK TARGET(CLP).

Rajendran, S. and Muthu, M. (1981). Post-Fumigation Productivity of Sitophilus oryzae (L.) (Coleoptera: Curculionidae) and Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae) Exposed to Acrylonitrile, Adjuvants of Acrylonitrile, Acrylonitrile-Adjuvant Mixtures and Other Modern Fumigants. *Bull.Entomol.Res.* 71: 163-169.

EcoReference No.: 89375
Chemical of Concern: ACY,3CE,CTC,MB,CLP,ETO,PPHN; Habitat: T; Effect Codes: MOR,REP; Rejection Code: OK(ETO,3CE,ACY,TARGET-CLP),NO ENDPOINT(CTC,MB,PPHN).

CHLOROPICRIN (April 2005)
Papers that Were Accepted for ECOTOX

Acceptable for ECOTOX and OPP

1. Carr, R. S. (1987). Memorandum. *July 21 Memo to Michael DeGraeve, Battelle Columbus Laboratories, Columbus,OH* 71 p.

   EcoReference No.: 17308
   Chemical of Concern: Mo,EDT,PCL,CLP,BTC,PPA,ACY,FUR; Habitat: A; Effect Codes: MOR; Rejection Code: less sensitive endpoint and no measured concentrations

2. Cook, R. J., Sitton, J. W., and Haglund, W. A. (1987). Influence of Soil Treatments on Growth and Yield of Wheat and Implications for Control of Pythium Root Rot. *Phytopathology* 77: 1192-1198.

   EcoReference No.: 77668
   Chemical of Concern: CLP; Habitat: T; Effect Codes: POP; Rejection Code: efficacy/not a selected endpoint

3. Csinos, A. S., Johnson, W. C., Johnson, A. W., Sumner, D. R., McPherson, R. M., and Gitaitis, R. D. (1997). Alternative Fumigants for Methyl Bromide in Tobacco and Pepper Transplant Production . *Crop Prot.* 16: 585-594.

   EcoReference No.: 77513
   Chemical of Concern: CLP,DPDP,MTAS,DZM; Habitat: T; Effect Codes: POP,PHY; Rejection Code: efficacy/not a selected endpoint

4. Csinos, A. S., Sumner, D. R., Johnson, W. C., Johnson, A. W., McPherson, R. M., and Dowler, C. C. (2000). Methyl Bromide Alternatives in Tobacco, Tomato and Pepper Transplant Production. *Crop Prot.* 19: 39-49.

   EcoReference No.: 77511
   Chemical of Concern: CLP,DPDP,MB,MTAS; Habitat: T; Effect Codes: POP,PHY; Rejection Code: efficacy/not a selected endpoint

5. Fortnum, B. A., Gooden, D. T., Currin III, R. E., and Martin, S. B. (1990). Spring or Fall Fumigation for Control of Meloidogyne spp. on Tobacco. *J.Nematol.* 22: 645-650.

   EcoReference No.: 77612
   Chemical of Concern: CLP,FMP,EP; Habitat: T; Effect Codes: POP; Rejection Code: efficacy/not a selected endpoint

6. Giller, S., Le Curieux, F., Gauthier, L., Erb, F., and Marzin, D. (1995). Genotoxicity Assay of Chloral Hydrate and Chloropicrine. *Mutat.Res.* 348: 147-152.

   EcoReference No.: 10365
   Chemical of Concern: CLP; Habitat: A; Effect Codes: CEL; Rejection Code: mutagenicity study –not a selected endpoint

7. Gilreath, J. P., Jones, J. P., Santos, B. M., and Overman, A. J. (2004). Soil Fumigant Evaluations for Soilborne Pest and Cyperus rotundus Control in Fresh Market Tomato. *Crop Prot.* 23: 889-893.

EcoReference No.: 77512
Chemical of Concern: CLP,MB,FTZ,DPDP,DZM,PEB,MTAS; Habitat: T; Effect Codes: POP; Rejection Code: efficacy/not a selected endpoint

8. Haar, M. J., Fennimore, S. A., Ajwa, H. A., and Winterbottom, C. Q. (2003). Chloropicrin Effect on Weed Seed Viability. *Crop Prot.* 22: 109-115.

EcoReference No.: 77528
Chemical of Concern: CLP,MTAS,MB; Habitat: T; Effect Codes: MOR; Rejection Code: efficacy/not a selected endpoint

9. Harris, D. C. (1991). A Comparison of Dazomet, Chloropicrin and Methyl Bromide as Soil Disinfestants for Strawberries. *J.Hortic.Sci.* 66: 51-58.

EcoReference No.: 77595
Chemical of Concern: CLP,DZM,MB; Habitat: T; Effect Codes: POP; Rejection Code: efficacy/not a selected endpoint

10. Jacobsohn, R., Kelman, Y., Shaked, R., and Klein, L. (1988). Broomrape (Orobanche-spp.) Control with Ethylene Dibromide and Chloropicrin. *Weed Res.* 28: 151-158.

EcoReference No.: 77590
Chemical of Concern: CLP; Habitat: T; Effect Codes: POP,REP; Rejection Code: efficacy/not a selected endpoint

11. Larson, K. D. and Shaw, D. V. (1995). Strawberry Nursery Soil Fumigation and Runner Plant Production. *Hortscience* 30: 236-237.

EcoReference No.: 77539
Chemical of Concern: CLP; Habitat: T; Effect Codes: GRO; Rejection Code: efficacy/not a selected endpoint

12. Locascio, S. J., Gilreath, J. P., Dickson, D. W., Kucharek, T. A., Jones, J. P., and Noling, J. W. (1997). Fumigant Alternatives to Methyl Bromide for Polyethylene-Mulched Tomato. *Hortscience* 32: 1208-1211.

EcoReference No.: 77526
Chemical of Concern: CLP,MTAS,DPDP,CLP,PEB,DZM; Habitat: T; Effect Codes: POP,PHY; Rejection Code: efficacy/not a selected endpoint

14. Melton, T. A. and Powell, N. T. (1991). Effects of Nematicides and Cultivars on Rotylenchulus reniformis and Flue-Cured Tobacco Yield. *J.Nematol.* 23: 712-716.

EcoReference No.: 77621
Chemical of Concern: CLP,UREA,EP,CBF,CPY,ADC,FMP; Habitat: T; Effect Codes: POP; Rejection Code: efficacy/not a selected endpoint

Acceptable for ECOTOX but not OPP

1. Ferriss, R. S., Stuckey, R. E., Gleason, M. L., and Siegel, M. R. (1987). Effects of Seed Quality, Seed Treatment, Soil Source, and Initial Soil Moisture on Soybean Seedling Performance. *Phytopathology* 77: 140-148.

   EcoReference No.: 77689
   Chemical of Concern: CLP,CBX,THM,MB; Habitat: T; Effect Codes: POP; Rejection Code: NO CONTROL(ALL CHEMS),MIXTURE(THM,CBX).

2. Gilreath, J. P. and Santos, B. M. (2004). Methyl Bromide Alternatives for Weed and Soilborne Disease Management in Tomato (Lycopersicon esculentum). *Crop Prot.* 23: 1193-1198.

   EcoReference No.: 77527
   Chemical of Concern: CLP,MTAS,PEB,DPDP,DZM,MB; Habitat: T; Effect Codes: PHY,POP; Rejection Code: OK(MTAS,DPDP,DZM),NO MIXTURE(MB,PEB),ENDPOINT,CONTROL(CLP).

3. Goodell, B., Hosli, J. P., and Kropp, B. (1987). The Diffusion and Toxicity of the Fumigant Chloropicrin Injected in Sugar Maple and White Birch Trees. *Can.J.For.Res.* 17: 1552-1556.

   EcoReference No.: 77629
   Chemical of Concern: CLP; Habitat: T; Effect Codes: ACC; Rejection Code: NO ENDPOINT(CLP).

4. Hutchinson, C. M., McGiffen, M. E. Jr., Ohr, H. D., Sims, J. J., and Becker, J. O. (2000). Efficacy of Methyl Iodide and Synergy with Chloropicrin for Control of Fungi. *Pest Manag.Sci.* 56: 413-418.

   EcoReference No.: 66179
   Chemical of Concern: CLP; Habitat: T; Effect Codes: MOR; Rejection Code: NO MIXTURE(CLP).

5. Hygnstrom, S. E. and VerCauteren, K. C. (2000). Cost-Effectiveness of Five Burrow Fumigants for Managing Black-Tailed Prairie Dogs. *Int.Biodeter.Biodegrad.* 45: 159-168.

   EcoReference No.: 77587
   Chemical of Concern: CLP,AlP,MB; Habitat: T; Effect Codes: POP; Rejection Code: NO ENDPOINT(ALL CHEMS).

6. Knight, K. L. (1940). Fumigation of Sacked Grain with Chloropicrin. *J.Econ.Entomol.* 33: 536-539.

   EcoReference No.: 27490
   Chemical of Concern: CLP; Habitat: T; Effect Codes: MOR; Rejection Code: NO CONTROL(CLP).

7. Koenning, S. R., Bailey, J. E., Schmitt, D. P., and Barker, K. R. (1998). Management of Plant-Parasitic Nematodes on Peanut with Selected Nematicides in North Carolina. *J.Nematol.* 30: 643-650.

   EcoReference No.: 77680
   Chemical of Concern: CLP,FMP,EP,ADC,CPY; Habitat: T; Effect Codes: POP; Rejection Code: OK(ADC,CPY,FMP,EP),NO MIXTURE(CLP).

8. Kutywayo, V. (2003). Chemical Alternatives for Soil Fumigation with Methyl Bromide on Tobacco Seedbeds in Nematode and Weed Control. *Commun.Appl.Biol.Sci.Ghent Univ.* 68: 115-122.

EcoReference No.: 77523
Chemical of Concern: CLP,MTAS,MB,DPDP; Habitat: T; Rejection Code: OK(MB,DPDP),NO MIXTURE(CLP,MTAS).

9. Moldenke, A. R. and Thies, W. G. (1996). Application of Chloropicrin to Control Laminated Root Rot: Research Design and Seasonal Dynamics of Control Populations of Soil Arthropods. *Environ.Entomol.* 25: 925-932.

EcoReference No.: 77507
Chemical of Concern: CLP; Habitat: T; Effect Codes: POP; Rejection Code: NO ENDPOINT(CLP).

10. Office of Pesticide Programs (2000). Pesticide Ecotoxicity Database (Formerly: Environmental Effects Database (EEDB)). *Environmental Fate and Effects Division, U.S.EPA, Washington, D.C.*

EcoReference No.: 344
Chemical of Concern: 24DXY,ACL,ACP,ACR,ALSV,AQS,ATZ,AZ,BDF,BMC,BML,BMN,BRSM,BS,BT,CaPS,Captan,CBF,CBL,CFE,CFE,CLNB,CLP,CMPH,CPC,CPY,CTN,CTZ,Cu,CuO,CuS,CYD,CYF,CYP,CYT,DBN,DCNA,DDAC,DFT,DFZ,DM,DMB,DMM,DMP,DMT,DOD,DPC,DPDP,DS,DSP,DU,DZ,DZM,EFL,EFS,EFV,EP,FHX,FMP,FO,Folpet,FPP,FVL,GYP,HCCH,HXZ,IPD,IZP,LNR,MAL,MB,MBZ,MDT,MFX,MFZ,MGK,MLN,MLT,MOM,MP,MTC,MTL,MTM,NAA,Naled,NFZ,NPP,NTP,OXF,OXT,OYZ,PCP,PCZ,PDM,PEB,PHMD,PMR,PMT,PNB,PPB,PPG,PPMH,PQT,PRB,PRT,PSM,PYN,PYZ,RSM,RTN,SMM,SMT,SS,SXD,SZ,TBC,TDC,TDF,TDZ,TET,TFN,TFR,TMT,TPR,TRB,WFN,ZnP; Habitat: AT; Effect Codes: MOR,POP,PHY,GRO,REP; Rejection Code: NO EFED (344).

11. Overman, A. J., Csizinszky, A. A., Jones, J. P., and Stanley, C. D. (1987). Efficacy of Metam Sodium Applied via Drip Irrigation on Tomato. *In: 46th Annu.Meet.of the Soil and Crop Sci.Soc.of Fla., Oct.14-16, 1986, Longboat Key, FL, Soil Crop Sci.Soc.Fla.Proc.* 4-7.

EcoReference No.: 77557
Chemical of Concern: CLP,MB,MTAS; Habitat: T; Effect Codes: POP; Rejection Code: OK(MTAS),NO MIXTURE(MB,CLP).

12. Reynolds, L. B., Olthof, T. H. A., and Potter, J. W. (1992). Effect of Fumigant Nematicides on Yield and Quality of Paste Tomatoes Grown in Southwestern Ontario. *J.Nematol.* 24: 656-661.

EcoReference No.: 77622
Chemical of Concern: CLP,DPDP,MITC; Habitat: T; Effect Codes: POP; Rejection Code: OK(DPDP),NO MIXTURE(CLP,MITC).

13. Thies, W. G. and Nelson, E. E. (1987). Survival of Douglas-Fir Injected with the Fumigants Chloropicrin Methylisothiocyanate or Vorlex. *Northwest.Sci.* 61: 60-64.

EcoReference No.: 77690
Chemical of Concern: CLP; Habitat: T; Effect Codes: MOR,PHY; Rejection Code: NO ENDPOINT(CLP).

14. Webster, T. M., Csinos, A. S., Johnson, A. W., Dowler, C. C., Sumner, D. R., and Fery, R. L. (2001). Methyl Bromide Alternatives in a Bell Pepper-Squash Rotation. *Crop Prot.* 20: 605-614.

EcoReference No.: 77510

Chemical of Concern: CLP,MB,DPDP,FMP; Habitat: T; Effect Codes: PHY,POP; Rejection Code: OK(MB),NO MIXTURE(CLP,DPDP,FMP).

15. Weingartner, D. P. and Shumaker, J. R. (1990). Effects of Soil Fumigants and Aldicarb on Nematodes, Tuber Quality, and Yield in Potato. *J.Nematol.* 22: 767-774.

EcoReference No.: 77626
Chemical of Concern: CLP,ADC,DPDP; Habitat: T; Effect Codes: POP; Rejection Code: OK(DPDP),NO MIXTURE(ADC,CLP).

CHLOROPICRIN (April 2005)
Papers that Were Excluded from ECOTOX

1. 1987). LABORATORY VOLATILITY STUDY WITH METHYL BROMIDE AND CHLOROPICRIN WITH ATTACHMENTS. *EPA/OTS; Doc #86-870000924*.
Rejection Code: NO SPECIES.

2. 2000). TELONE C-17 SOIL FUNGICIDE AND NEMATICIDE: DERMAL SENSITIZATION POTENTIAL IN THE HARTLEY ALBINO GUINEA PIG WITH ATTACHMENTS AND COVER LETTER DATED 091388. *EPA/OTS; Doc #86-880000357*.
Rejection Code: HUMAN HEALTH.

3. 2000). TELONE C-17 SOIL FUNGICIDE AND NEMATICIDE: PRIMARY DERMAL IRRITATION STUDY IN NEW ZEALAND WHITE RABBITS (FINAL REPORT) WITH COVER LETTER DATED 092688. *EPA/OTS; Doc #86-890000001*.
Rejection Code: HUMAN HEALTH.

4. 1988). TELONE C-17 SOIL FUNGICIDE AND NEMATOCIDE: A ONE HOUR ACUTE VAPOR INHALATION STUDY IN FISCHER 344 RATS WITH COVER LETTER DATED 121588. *EPA/OTS; Doc #86-890000062*.
Rejection Code: INHALE.

5. 1981). TSCA SECTION 8(E) REPORT-CHLOROPICRIN LEAK AT BERTH 24-PORT OF LONG BEACH, CALIFORNIA ON AUGUST 18, 1981 WITH EPA RESPONSE DATED 102181. *EPA/OTS; Doc #88-8100284*.
Rejection Code: INCIDENT.

6. Anderson, R. C. and Liberta, A. E. (1992). Influence of Supplemental Inorganic Nutrients on Growth, Survivorship, and Mycorrhizal Relationships of Schizachyrium scoparium (Poaceae) Grown in Fumigated and Unfumigated Soil. *Am.J.Bot.* 79: 406-414.
Rejection Code: MIXTURE.

7. ANON (1988). A MASSIVE FUMIGATION. *PEST CONTROL; 56* 48-50.
Rejection Code: NO SOURCE.

8. AUGER, J., BIRKETT MA, COATS, J., COHEN SZ, HAWKES TR, LUCCA, P., NARAYANAN

KS, POTRYKUS, I., and ROBERTSON, A. (1998). All specialisations were catered for at the IUPAC conference (London, UK: August, 1998; IUPAC). *INTERNATIONAL PEST CONTROL; 40* 204-207.
Rejection Code: REVIEW.

9. BEAVIS, C., SIMPSON, P., SYME, J., and RYAN, C. (1991). QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES INFORMATION SERIES QI91006. INFOPEST CHEMICALS FOR THE PROTECTION OF FIELD CROPS FORAGE CROPS AND PASTURES 2ND EDITION. *BEAVIS, C., P. SIMPSON, J. SYME AND C. RYAN. QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES INFORMATION SERIES, QI91006. INFOPEST: CHEMICALS FOR THE PROTECTION OF FIELD CROPS, FORAGE CROPS AND PASTURES, 2ND EDITION. VI+312P. QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES: BRISBANE, QUEENSLAND, AUSTRALIA. PAPER. ISBN 0-7242-3985-5.; 0* VI+312P.
Rejection Code: NO TOX DATA.

10. BOLLAG J-M and LIU S-Y (1990). BIOLOGICAL TRANSFORMATION PROCESSES OF PESTICIDES. *CHENG, H. H. (ED.). SSSA (SOIL SCIENCE SOCIETY OF AMERICA) BOOK SERIES, NO. 2. PESTICIDES IN THE SOIL ENVIRONMENT: PROCESSES, IMPACTS, AND MODELING. XXIII+530P. SOIL SCIENCE SOCIETY OF AMERICA, INC.: MADISON, WISCONSIN, USA. ILLUS. ISBN 0-89118-791-X.; 0 (0). 1990. 169-212.*
Rejection Code: METABOLISM.

11. BRUST GE and SCOTT WD (1994). COMPARING THE EFFICACY OF CHEMICAL CONTROLS FOR ROOT-KNOT NEMATODE ON WATERMELON. *91ST ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, CORVALLIS, OREGON, USA, AUGUST 7-10, 1994. HORTSCIENCE; 29 (5). 1994. 471. AB - BIOSIS COPYRIGHT: BIOL ABS. RRM ABSTRACTS ONLY MELOIDOGYNE-SPP INVERTEBRATE PLANT HORTICULTURE METHAM SODIUM METHYL BROMIDE CHLOROPICRIN OXAMYL FOSTHIAZATE PESTICIDE YIELD.*
Rejection Code: ABSTRACT.

12. CASTRO CE, YOKOYAMA, W., and BELSER NO (1987). BIODEHALOGENATION COMPARATIVE REACTIVITIES OF CYTOCHROMES P-450 WITH HEME AND WHOLE CELL MODELS. *193RD AMERICAN CHEMICAL SOCIETY NATIONAL MEETING, DENVER, COLORADO, USA, APRIL 5-10, 1987. ABSTR PAP AM CHEM SOC; 193* NO PAGINATION.
Rejection Code: ABSTRACT.

13. Cervini-Silva, J, Larson, R A, Wu, J, and Stucki, J W (2001). Transformation of chlorinated aliphatic compounds by ferruginous smectite. *Environmental Science & Technology* 35: 805-809.
Rejection Code: FATE.

14. CHEN WJ and WEISEL CP (1998). Halogenated DBP concentrations in a distribution system. *AMERICAN WATER WORKS ASSOCIATION JOURNAL; 90* 151-163.
Rejection Code: EFFLUENT.

15. COHEN, S., SVRJCEK, A., DURBOROW, T., and BARNES NL (1999). Water quality impacts by golf courses. *JOURNAL OF ENVIRONMENTAL QUALITY; 28* 798-809.
Rejection Code: REVIEW.

16. DAFT JL (1989). DETERMINATION OF FUMIGANTS AND RELATED CHEMICALS IN FATTY AND NONFATTY FOODS. *J AGRIC FOOD CHEM; 37* 560-564.

Rejection Code: HUMAN HEALTH.

17. Desaeger, Johan Aj, Eger, Joe E Jr, Csinos, Alex S, Gilreath, James P, Olson, Steve M, and Webster, Theodore M (2004). Movement and biological activity of drip-applied 1,3-dichloropropene and chloropicrin in raised mulched beds in the southeastern USA. *Pest Management Science* 60: 1220-1230.
Rejection Code: FATE.

18. DICKSON DW (1997). ALTERNATIVES TO METHYL BROMIDE FOR CONTROL OF NEMATODE AND SOILBORNE DISEASES. *36TH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS, TUCSON, ARIZONA, USA, JULY 19-23, 1997. JOURNAL OF NEMATOLOGY* 29: 575.
Rejection Code: ABSTRACT.

19. DOLL CC and RIES SM (1986). FUMIGATION OF PEACH REPLANT SITES. *XXII INTERNATIONAL HORTICULTURAL CONGRESS HELD AT THE 83RD ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, DAVIS, CALIF., USA, AUG. 10-18, 1986. HORTSCIENCE; 21* 776.
Rejection Code: ABSTRACT.

20. DUGUET JP, TSUTSUMI, Y., BRUCHET, A., and MALLEVIALLE, J. (1985). CHLOROPICRIN IN POTABLE WATER CONDITIONS OF FORMATION AND PRODUCTION DURING TREATMENT PROCESSES. *JOLLEY, R. L. ET AL. (ED.). WATER CHLORINATION, VOL. 5. CHEMISTRY, ENVIRONMENTAL IMPACT AND HEALTH EFFECTS. FIFTH CONFERENCE ON WATER CHLORINATION: ENVIRONMENTAL IMPACT AND HEALTH EFFECTS, WILLIAMSBURG, VA., USA, JUNE 3-8, 1984. XX+1575P. LEWIS PUBLISHERS, INC.: CHELSEA, MICH., USA. ILLUS. MAPS. ISBN 0-87371-005-3.; 0 (0). 1985. 1201-1214.*
Rejection Code: EFFLUENT.

21. ENGELBRECHT MC, VAN WYK RJ, ENGELBRECHT, S. LG, and VAN RENSBURG J NJ (1990). Control of bacterial wilt of tobacco with chloropicrin in South Africa. *PHYTOPHYLACTICA; 22* 269-271.
Rejection Code: BACTERIA.

22. ESTES EA, SKROCH WA, KONSLER TR, SHOEMAKER PB, and SORENSEN KA (1985). NET ECONOMIC VALUES OF EIGHT SOIL MANAGEMENT PRACTICES USED IN STAKE TOMATO LYCOPERSICON-ESCULENTUM PRODUCTION. *J AM SOC HORTIC SCI; 110* 812-816.
Rejection Code: NO TOX DATA.

23. FORT SB and SHAW DV (1998). Phenotypic correlations between root and shoot traits of strawberry in fumigated nonfumigated soils. *HORTSCIENCE; 33* 222-224.
Rejection Code: MIXTURE.

24. FORT SB, SHAW DV, and LARSON KD (1996). Performance responses of strawberry seedlings to the sublethal effects of nonfumigated soils. *JOURNAL OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE; 121* 367-370.
Rejection Code: MIXTURE.

25. FORTNUM BA, GOODEN DT, CURRIN, R. E. III, and MARTIN SB (1989). SPRING OR FALL FUMIGATION FOR CONTROL OF MELOIDOGYNE-SPP ON TOBACCO. *TWENTY-EIGHTH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS, DAVIS, CALIFORNIA, USA, AUGUST 13-17, 1989. J NEMATOL; 21* 561.

Rejection Code: ABSTRACT.

26. FORTNUM BA and PULLEN MP (1992). CONTROL OF ROOT-KNOT DISEASE COMPLEXES ON FLUE-CURED TOBACCO WITH SOIL FUMIGATION AND PLASTIC MULCH. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, PORTLAND, OREGON, USA, AUGUST 8-12, 1992. PHYTOPATHOLOGY; 82* 1096.
Rejection Code: ABSTRACT.

27. GERBA CP (1996). MUNICIPAL WASTE AND DRINKING WATER TREATMENT. *PEPPER, I. L., C. P. GERBA AND M. L. BRUSSEAU (ED.). POLLUTION SCIENCE. XXIV+397P. ACADEMIC PRESS, INC.: SAN DIEGO, CALIFORNIA, USA; LONDON, ENGLAND, UK. ISBN 0-12-550660-0.; 0 (0). 1996. 301-319.*
Rejection Code: EFFLUENT.

28. Gilreath, J. P. and Santos, B. M. (2004). Herbicide Dose and Incorporation Depth in Combination with 1,3-Dichloropropene plus Chloropicrin for Cyperus rotundus Control in Tomato and Pepper. *Crop Prot.* 23: 205-210.
Rejection Code: MIXTURE.

29. Gilreath, J. P., Santos, B. M., Gilreath, P. R., Jones, J. P., and Noling, J. W. (2004). Efficacy of 1,3-Dichloropropene plus Chloropicrin Application Methods in Combination with Pebulate and Napropamide in Tomato. *Crop Prot.* 23: 1187-1191.
Rejection Code: MIXTURE.

30. Gilreath, James P., Motis, Timothy N., and Santos, Bielinski M. (2005). Cyperus spp. control with reduced methyl bromide plus chloropicrin doses under virtually impermeable films in pepper. *Crop Protection* 24: 285-287.
Rejection Code: MIXTURE.

31. Gilreath, James P. and Santos, Bielinski M. (2004). Herbicide dose and incorporation depth in combination with 1,3-dichloropropene plus chloropicrin for Cyperus rotundus control in tomato and pepper. *Crop Protection* 23: 205-210.
Rejection Code: MIXTURE.

32. Golfinopoulos, Spyros K, Nikolaou, Anastasia D, and Lekkas, Themistokles D (2003). The occurrence of disinfection by-products in the drinking water of Athens, Greece. *Environmental Science And Pollution Research International* 10: 368-372.
Rejection Code: EFFLUENT.

33. GRAHAM JH, MCGUIRE RG, and MILLER JW (1987). SURVIVAL OF XANTHOMAS-CAMPESTRIS PATHOVAR CITRI IN CITRUS PLANT DEBRIS AND SOIL IN FLORIDA USA AND ARGENTINA. *PLANT DIS; 71* 1094-1098.
Rejection Code: SURVEY.

34. GRAY FA, KOCH DW, GERIK JS, and FISHER GA (1998). COMPARISON OF TWO SOIL FUMIGANTS FOR CONTROL OF FUSARIUM OXYSPORUM F.SP. BETAE AND HETERODERA SCHACHTII. *MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, PACIFIC DIVISION, FORT COLLINS, COLORADO, USA, JUNE 27-28, 1997. PHYTOPATHOLOGY; 88* S107.
Rejection Code: ABSTRACT.

35. Gullino, M Lodovica, Minuto, Andrea, and Garibaldi, Angelo (2002). Soil fumigation with chloropicrin in Italy: experimental results on melon, eggplant and tomato. *Mededelingen (Rijksuniversiteit Te Gent. Fakulteit Van De Landbouwkundige En Toegepaste Biologische*

Wetenschappen) 67: 171-180.
Rejection Code: FATE.

36. Guo, Mingxin , Papiernik, Sharon K, Zheng, Wei, and Yates, Scott R (2003). Formation and extraction of persistent fumigant residues in soils. *Environmental Science & Technology* 37: 1844-1849.
Rejection Code: FATE.

37. Guo, Mingxin , Yates, Scott R, Zheng, Wei, and Papiernik, Sharon K (2003). Leaching potential of persistent soil fumigant residues. *Environmental Science & Technology* 37: 5181-5185.
Rejection Code: FATE.

38. Hague, N. G. M. and Gowen, S. R. (1987). Chemical Control of Nematodes. *In: R.H.Brown and B.R.Kerry (Eds.), Principles and Practice of Nematode Control in Crops, Chapter 5, Acad.Press Inc., San Diego, CA* 131-178.
Rejection Code: REVIEW.

39. HARRIS DC (1990). Control of verticillium wilt and other soil-borne diseases of strawberry in Britain by chemical soil disinfestation.
Rejection Code: NO SOURCE.

40. HEALD CM (1989). CONTROL OF MELOIDOGYNE-HAPLA INFECTING ROSES. *TWENTY-EIGHTH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS, DAVIS, CALIFORNIA, USA, AUGUST 13-17, 1989. J NEMATOL; 21* 564-565.
Rejection Code: ABSTRACT.

41. HIMELRICK DG , WOODS FM, and DOZIER, W. A. JR (1995). EFFECT OF SOIL FUMIGATION AND SOIL SOLARIZATION ON ANNUAL HILL STRAWBERRY PRODUCTION. *92ND ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE AND THE 40TH ANNUAL CONGRESS OF THE CANADIAN SOCIETY FOR HORTICULTURAL SCIENCE, MONTREAL, QUEBEC, CANADA, JULY 30-AUGUST 3, 1995. HORTSCIENCE; 30* 800.
Rejection Code: ABSTRACT.

42. HOLLIGER, C. and SCHRAA, G. (1994). PHYSIOLOGICAL MEANING AND POTENTIAL FOR APPLICATION OF REDUCTIVE DECHLORINATION BY ANAEROBIC BACTERIA. *FEMS MICROBIOLOGY REVIEWS; 15* 297-305.
Rejection Code: BACTERIA.

43. Hutchinson, Chad M, McGiffen, Milton E Jr, Sims, James J, and Becker, J Ole (2004). Fumigant combinations for Cyperus esculentum L control. *Pest Management Science* 60: 369-374.
Rejection Code: MIXTURE.

44. Ibekwe, A M, Papiernik, S K, Gan, J, Yates, S R, Yang, C H, and Crowley, D E (2001). Impact of fumigants on soil microbial communities. *Applied And Environmental Microbiology* 67: 3245-3257.
Rejection Code: BACTERIA.

45. IWASAKI, M., YOSHIDA, M., IKEDA, T., TSUDA, S., and SHIRASU, Y. (1985). COMPARISON OF WHOLE BODY EXPOSURE VS. SNOUT ONLY EXPOSURE IN INHALATION TOXICITY. *21ST ANNUAL MEETING OF THE JAPANESE SOCIETY OF TOXICOLOGICAL SCIENCES, TOKYO, JAPAN, JULY 1-2, 1985. J TOXICOL SCI; 10* 257.

Rejection Code: INHALE.

46. Johnson, A. W., Dowler, C. C., Glaze, N. C., Sumner, D. R., Chalfant, R. B., Golden, A. M., and Epperson, J. E. (1990). Effects of Nematicides on Nematode Population Densities and Crop Yield in a Turnip-Corn-Pea Cropping System. *Phytoprotection* 71: 55-64.
Rejection Code: MIXTURE.

47. JUUTI, S., VARTIANINEN, T., JOUTSENOJA, P., and RUUSKANEN, J. (1996). Volatile organochlorine compounds formed in the bleaching of pulp with ClO2. *CHEMOSPHERE; 33* 437-448.
Rejection Code: EFFLUENT.

48. Kampioti, Adamantia A. and Stephanou, Euripides G. (2002). The impact of bromide on the formation of neutral and acidic disinfection by-products (DBPs) in Mediterranean chlorinated drinking water. *Water Research* 36: 2596-2606.
Rejection Code: EFFLEUNT.

49. Kennedy, G. L. Jr. and Graepel, G. J. (1991). Acute Toxicity in the Rat Following Either Oral or Inhalation Exposure. *Toxicol.Lett.* 56: 317-326.
Rejection Code: REFS CHECKED/REVIEW.

50. Kim, Jung-Ho , Gan, Jianying, Farmer, Walter J, Yates, Scott R, Papiernik, Sharon K, and Dungan, Robert S (2003). Organic matter effects on phase partition of 1,3-dichloropropene in soil. *Journal Of Agricultural And Food Chemistry* 51: 165-169.
Rejection Code: FATE.

51. Klose, Susanne and Ajwa, Husein A. (2004). Enzyme activities in agricultural soils fumigated with methyl bromide alternatives. *Soil Biology and Biochemistry* 36: 1625-1635.
Rejection Code: BACTERIA.

52. KRISHNAN, K. , PATERSON, J., and WILLIAMS DT (1997). Health risk assessment of drinking water contaminants in Canada: The applicability of mixture risk assessment methods. *REGULATORY TOXICOLOGY AND PHARMACOLOGY; 26* 179-187.
Rejection Code: EFFLUENT.

53. LANIEWSKI, K., BOREN, H., and GRIMVALL, A. (1998). Identification of volatile and extractable chloroorganics in rain and snow. *ENVIRONMENTAL SCIENCE & TECHNOLOGY; 32* 3935-3940.
Rejection Code: SURVEY.

54. LARSON KD (1994). NURSERY SOIL FUMIGATION TREATMENT STOLON PRODUCTION AND SUBSEQUENT GROWTH OF STRAWBERRY PLANTS IN CALIFORNIA. *91ST ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, CORVALLIS, OREGON, USA, AUGUST 7-10, 1994. HORTSCIENCE; 29 (5). 1994. 453. AB - BIOSIS COPYRIGHT: BIOL ABS. RRM ABSTRACTS ONLY CULTIVAR CHANDLER CULTIVAR SELVA PLANT HORTICULTURE GENERAL PESTICIDE CHLOROPICRIN METHYL BROMIDE PEST CONTROL DISEASE CONTROL RUNNER PRODUCTION VIGOR NEGATIVE CULTIVAR EFFECTS USA.*
Rejection Code: ABSTRACT.

55. LARSON KD and SHAW DV (1994). PERFORMANCE OF TWELVE STRAWBERRY GENOTYPES IN FUMIGATED AND NONFUMIGATED SOIL. *91ST ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, CORVALLIS, OREGON, USA, AUGUST 7-10, 1994. HORTSCIENCE; 29 (5). 1994. 429.*

AB - BIOSIS COPYRIGHT: BIOL ABS. RRM ABSTRACTS ONLY FRAGARIA-ANANASSA PATHOGENS SOIL ORGANISM PLANT HORTICULTURE GENETICS YIELD PRODUCTIVITY SOIL FUMIGATION METHYL BROMIDE CHLOROPICRIN.
Rejection Code: ABSTRACT.

56. LARSON KD and SHAW DV (1995). Relative performance of strawberry genotypes on fumigated and nonfumigated soils. *JOURNAL OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE; 120* 274-277.
Rejection Code: MIXTURE.

57. LARSON KD and SHAW DV (1996). Soil fumigation, fruit production, and dry matter partitioning of field grown-strawberry plants. *JOURNAL OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE; 121* 1137-1140.
Rejection Code: MIXTURE.

58. LARSON KD, SHAW DV, and STERRETT, J. (1995). YIELD AND DRY MATTER PARTITIONING OF STRAWBERRY PLANTS GROWN WITH THREE PREPLANT SOIL FUMIGATION TREATMENTS. *92ND ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE AND THE 40TH ANNUAL CONGRESS OF THE CANADIAN SOCIETY FOR HORTICULTURAL SCIENCE, MONTREAL, QUEBEC, CANADA, JULY 30-AUGUST 3, 1995. HORTSCIENCE; 30* 781.
Rejection Code: ABSTRACT.

59. LEBEL GL, BENOIT FM, and WILLIAMS DT (1997). A one-year survey of halogenated disinfection by-products in the distribution system of treatment plants using three different disinfection processes. *CHEMOSPHERE; 34* 2301-2317.
Rejection Code: EFFLUENT.

60. Lee, K J, Kim, B H, Hong, J E, Pyo, H S, Park, S J, and Lee, D W (2001). A study on the distribution of chlorination by-products (CBPs) in treated water in Korea. *Water Research* 35: 2861-2872.
Rejection Code: EFFLUENT.

61. Lee, S., McLaughlin, R., Harnly, M., Gunier, R., and Kreutzer, R. (Community Exposures to Airborne Agricultural Pesticides in California: Ranking of Inhalation Risks. *Environmental Health Perspectives [Environ. Health Perspect.]. Vol. 110, no. 12, pp. 1175-1184. Dec 2002.*
Rejection Code: HUMAN HEALTH.

62. LOCASCIO SJ and DICKSON DW (1998). METAM SODIUM COMBINED WITH CHLOROPICRIN AS AN ALTERNATIVE TO METHYL BROMIDE FUMIGATION FOR TOMATO. *95TH ANNUAL INTERNATIONAL CONFERENCE OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, CHARLOTTE, NORTH CAROLINA, JULY 12-15, 1998. HORTSCIENCE; 33* 524-525.
Rejection Code: ABSTRACT.

63. LOCASCIO SJ, GILREATH JP, DICKSON DW, KUCHAREK TA, JONES JP, and NOLING JW (1996). FUMIGANT ALTERNATIVES TO METHYL BROMIDE FOR POLYETHYLENE-MULCHED TOMATO. *93RD ANNUAL CONFERENCE OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, LEXINGTON, KENTUCKY, USA, OCTOBER 6-10, 1996. HORTSCIENCE; 31* 568.
Rejection Code: ABSTRACT.

64. Martin, Frank N (2003). Development of alternative strategies for management of soilborne

pathogens currently controlled with methyl bromide. *Annual Review Of Phytopathology* 41: 325-350 .
Rejection Code: REVIEW.

65. MARTIN JK and KEMP JR (1986). THE MEASUREMENT OF CARBON TRANSFER WITHIN THE RHIZOSPHERE OF WHEAT GROWN IN FIELD PLOTS. *SOIL BIOL BIOCHEM; 18* 103-108.
Rejection Code: METABOLISM.

66. MCDONALD MR, KOOI, K. VANDER, and JANSE, S. (1999). Band fumigation improves carrot quality with reduced rates of fumigant. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, MONTREAL, QUEBEC, CANADA, AUGUST 7-11, 1999.YPHYTOPATHOLOGY; 89* S50.
Rejection Code: ABSTRACT.

67. McSorley, R., Stansly, P. A., Noling, J. W., Obreza, T. A., and Conner, J. M. (1997). Impact of Organic Soil Amendments and Fumigation on Plant-Parasitic Nematodes in a Southwest Florida Vegetable Field. *Nematropica* 27: 181-189.
Rejection Code: MIXTURE.

68. MEANS, E. G. III and KRASNER SW (1993). D-DBP REGULATION ISSUES AND RAMIFICATIONS. *AM WATER WORKS ASSOC J; 85* 68-73.
Rejection Code: EFFLUENT.

69. MELICHAR MW and ROBY DM (1995). TELONE SOIL FUMIGANTS REGULATORY AND RESEARCH UPDATE. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL ASSOCIATION, PITTSBURGH, PENNSYLVANIA, USA, AUGUST 12-16, 1995. PHYTOPATHOLOGY; 85* 1140.
Rejection Code: ABSTRACT.

70. MELTON TA (1996). USE OF NEMATICIDES FOR THREE CONTINUOUS YEARS TO CONTROL MELOIDOGYNE SPP. ON NICOTIANA TABACUM. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, NORTH CENTRAL DIVISION, INDIANAPOLIS, INDIANA, USA, JULY 27-31, 1996. PHYTOPATHOLOGY; 86* S2.
Rejection Code: ABSTRACT.

71. MENGE JA and NEMEC, S. (1997). CITRUS. *HILLOCKS, R. J. AND J. M. WALLER (ED.). SOILBORNE DISEASES OF TROPICAL CROPS. X+452P. CAB INTERNATIONAL: WALLINGFORD, ENGLAND, UK; NEW YORK, NEW YORK, USA. ISBN 0-85199-121-1.; 0 (0). 1997. 185-227.*
Rejection Code: NO TOX DATA.

72. MILLER LG, CONNELL TL, GUIDETTI JR, and OREMLAND RS (1997). Bacterial oxidation of methyl bromide in fumigated agricultural soils. *APPLIED AND ENVIRONMENTAL MICROBIOLOGY; 63* 4346-4354.
Rejection Code: METABOLISM.

73. MOORMAN TB (1989). A REVIEW OF PESTICIDE EFFECTS ON MICROORGANISMS AND MICROBIAL PROCESSES RELATED TO SOIL FERTILITY. *J PROD AGRIC; 2* 14-23.
Rejection Code: REVIEW.

74. MORRELL JJ, FORSYTH PG, and THIES WG (1995). Distribution of methylisothiocyanate and chloropicrin in boles or roots of Douglas-fir trees. *CANADIAN JOURNAL OF FOREST RESEARCH; 24* 2324-2329.

Rejection Code: FATE.

75. MORRELL JJ and NEWBILL MA (1990). Movement of chloropicrin or methylisothiocyanate through the boles of Douglas-fir trees. *FOR SCI; 36* 192-195.
Rejection Code: FATE.

76. MURAYAMA, T. (1987). JAPANESE PESTICIDES GUIDE. *MURAYAMA, T. (ED.). JAPANESE PESTICIDES GUIDE. XIV+223P. JAPAN PLANT PROTECTION ASSOCIATION: TOKYO, JAPAN. ILLUS. PAPER. ISBN 4-89051-000-1.; 0 (0). 1987. XIV+223P.*
Rejection Code: NO TOX DATA.

77. NAGANAWA, T. , KYUMA, K., MORIYAMA, Y., YAMAMOTO, H., and TATSUYAMA, K. (1990). Changes of soil respiration after partial sterilization by autoclaving or addition of agrochemicals. *SOIL SCI PLANT NUTR; 36* 587-592.
Rejection Code: BACTERIA.

78. NELSON EE, THIES WG, and MCWILLIAMS MG (1995). Trichoderma spp. from roots of fumigated Douglas-fir trees infected with Phellinus weirii. *MYCOLOGIA; 87* 639-642.
Rejection Code: SURVEY.

79. NIEMINSKI EC , CHAUDHURI, S., and LAMOREAUX, T. (1993). The occurrence of DBPs in Utah drinking waters. *AM WATER WORKS ASSOC J; 85* 98-105.
Rejection Code: EFFLUENT.

80. Nikolaou, Anastasia D, Golfinopoulos, Spyros K, and Lekkas, Themistokles D (2002). Formation of organic by-products during chlorination of natural waters. *Journal Of Environmental Monitoring: JEM* 4: 910-916.
Rejection Code: FATE.

81. NIRA, R., HASHIMOTO, T., MATSUZAKI, M., and NISHIMUNE, A. (1996). Nitrogen transformations and availability in soils with application of fumigants. *SOIL SCIENCE AND PLANT NUTRITION; 42* 261-268.
Rejection Code: NO SPECIES.

82. Nishizawa, T. (1999). Major Plant-Parasitic Nematodes and Their Control in Japany. *Agrochem.Jpn.* 74: 2-9.
Rejection Code: REVIEW.

83. O'BRIEN RD and VAN BRUGGEN A HC (1990). Soil fumigation with dazomet and methyl bromide for control of corky root of iceberg lettuce. *PLANT DIS; 74* 1022-1025.
Rejection Code: MIXTURE.

84. OLSON SM and NOLING JW (1994). EVALUATION OF ALTERNATIVE FUMIGANTS FOR TOMATO PRODUCTION. *91ST ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, CORVALLIS, OREGON, USA, AUGUST 7-10, 1994. HORTSCIENCE; 29 (5). 1994. 524. AB - BIOSIS COPYRIGHT: BIOL ABS. RRM MEETING ABSTRACT MEETING POSTER PLANT ROOT KNOT NEMATODE CONTROL INVERTEBRATE CROP INDUSTRY HORTICULTURE METHYLBROMIDE REPLACEMENT METHAM SODIUM DAZOMET 1 3-DICHLOROPROPENE CHLOROPICRIN.*
Rejection Code: ABSTRACT.

85. OU L-T (1998). Enhanced degradation of the volatile fumigant-nematicides 1,3-D and methyl bromide in soil. *JOURNAL OF NEMATOLOGY; 30* 56-64.

Rejection Code: FATE.

86. Papiernik, Sharon K and Yates, Scott R (2002). Effect of environmental conditions on the permeability of high density polyethylene film to fumigant vapors. *Environmental Science & Technology* 36: 1833-1838.
Rejection Code: NO TOX DATA.

87. PETERSON CJ and COATS JR (1998). NATURALLY OCCURRING FUMIGANT INSECTICIDES CYANOHYDRINS AND GLUCOSINOLATES. *216TH NATIONAL MEETING OF THE AMERICAN CHEMICAL SOCIETY, BOSTON, MASSACHUSETTS, USA, AUGUST 23-27, 1998. ABSTRACTS OF PAPERS AMERICAN CHEMICAL SOCIETY; 216* AGRO 85.
Rejection Code: ABSTRACT.

88. PORTER IJ, BRETT RW, and WISEMAN BM (1999). Alternatives to methyl bromide: Chemical fumigants or integrated pest management systems? *AUSTRALASIAN PLANT PATHOLOGY; 28* 65-71.
Rejection Code: NO TOX DATA.

89. RIEGEL, C., DICKSON DW, OU L-T, and PETERSON LG (1998). MANAGEMENT OF ROOT-KNOT NEMATODES IN SOIL ENHANCED FOR DEGRADING 1 3-DICHLOROPROPENE . *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, LAS VEGAS, NEVADA, USA, NOVEMBER 8-12, 1998. PHYTOPATHOLOGY; 88* S76.
Rejection Code: ABSTRACT.

90. RODRIGUEZ-KABANA, R. and KOKALIS-BURELLE, N. (1997). CHEMICAL AND BIOLOGICAL CONTROL. *HILLOCKS, R. J. AND J. M. WALLER (ED.). SOILBORNE DISEASES OF TROPICAL CROPS. X+452P. CAB INTERNATIONAL: WALLINGFORD, ENGLAND, UK; NEW YORK, NEW YORK, USA. ISBN 0-85199-121-1.; 0 (0). 1997. 397-418.*
Rejection Code: REVIEW.

91. Selala, M. I., Janssens, J. J., Jorens, P. G., Bossaert, L. L., Beaucourt, L., and Schepens, P. J. C. (1989). An improperly labeled container with chloropicrin: A farmer's nightmare. *Bulletin of Environmental Contamination and Toxicology [BULL. ENVIRON. CONTAM. TOXICOL.]* 42: 202-208.
Rejection Code: INCIDENT.

92. SHAW DV and LARSON KD (1999). A meta-analysis of strawberry yield response to preplant soil fumigation with combinations of methyl bromide-chloropicrin and four alternative systems. *HORTSCIENCE; 34* 839-845.
Rejection Code: MIXTURE.

93. Shepherd, J. A. and Barker, K. R. (1990). Nematode Parasites of Tobacco. *In: M.Luc, R.A.Sokora, and J.Bridge (Eds.), Plant Parasitic Nematodes in Subtropical and Tropical Agriculture, CAB Int., Wallingford, England* 493-518.
Rejection Code: REVIEW.

94. Sparks, S E, Quistad, G B, Li, W, and Casida, J E (2000). Chloropicrin dechlorination in relation to toxic action . *Journal Of Biochemical And Molecular Toxicology* 14: 26-32.
Rejection Code: METABOLISM.

95. SPARKS SE, QUISTAD GB, and CASIDA JE (1997). CHLOROPICRIN REACTIONS WITH

BIOLOGICAL THIOLS AND METABOLISM IN MICE. *213TH NATIONAL MEETING OF THE AMERICAN CHEMICAL SOCIETY, SAN FRANCISCO, CALIFORNIA, USA, APRIL 13-17, 1997. ABSTRACTS OF PAPERS AMERICAN CHEMICAL SOCIETY* 213: AGRO 32.
Rejection Code: ABSTRACT.

96. SPETH TF and MILTNER RJ (1998). Technical note: Adsorption capacity of GAC for synthetic organics. *AMERICAN WATER WORKS ASSOCIATION JOURNAL; 90* 171-174.
Rejection Code: CHEM METHODS.

97. Spokas, K. and Wang, D. (2003). Stimulation of nitrous oxide production resulted from soil fumigation with chloropicrin. *Atmospheric Environment* 37: 3501-3507.
Rejection Code: BACTERIA.

98. Spokas, Kurt , Wang, Dong, and Venterea, Rodney (2005). Greenhouse gas production and emission from a forest nursery soil following fumigation with chloropicrin and methyl isothiocyanate. *Soil Biology and Biochemistry* 37: 475-485.
Rejection Code: NO TOX DATA.

99. Stansly, P. A. and Conner, J. P. (1996). Control of Tomato Pinworm TPW Keiferia Lycopersicella with Fermentation Product Insecticides Spring 1995. *In: A.K.Burditt,Jr.(Ed.), Arthropod Management Tests, Volume 21, Entomol.Soc.of Am., Landham, MD* 21: 190-191.
Rejection Code: MIXTURE.

100. STANSLY PA and CONNER JM (1996). CONTROL OF SOUTHERN ARMYWORM WITH BACILLUS THURINGIENSIS IN STAKED TOMATO FALL 1994. *BURDITT, A. K. JR. (ED.). ARTHROPOD MANAGEMENT TESTS, VOL. 21. IV+462P. ENTOMOLOGICAL SOCIETY OF AMERICA: LANHAM, MARYLAND, USA. ISBN 0-938522-55-8.; 21 (0). 1996. 191.*
Rejection Code: ABSTRACT.

101. STIMMANN MW and FERGUSON MP (1990). PROGRESS REPORT VICE PRESIDENT'S TASK FORCE ON PEST CONTROL ALTERNATIVES POTENTIAL PESTICIDE USE CANCELLATIONS IN CALIFORNIA USA. *CALIF AGRIC; 44* 12-16.
Rejection Code: NO TOX DATA.

102. Sullivan, D. A., Holdsworth, M. T., and Hlinka, D. J. (2004). Control of off-gassing rates of methyl isothiocyanate from the application of metam-sodium by chemigation and shank injection. *Atmospheric Environment* 38: 2457-2470.
Rejection Code: FATE.

103. Sumner, D. R., Dowler, C. C., Johnson, A. W., Chalfant, R. B., Glaze, N. C., Phatak, S. C., and Epperson, J. E. (1985). Effect of Root Diseases and Nematodes on Yield of Corn Zea mays in an Irrigated Multiple-Cropping System with Pest Management. *Plant Dis.* 69: 382-387 .
Rejection Code: MIXTURE.

104. Tang, Man-Lai and Hirji, Karim F (2002). Simple polynomial multiplication algorithms for exact conditional tests of linearity in a logistic model. *Computer Methods And Programs In Biomedicine* 69: 13-23.
Rejection Code: MODELING.

105. TAYLOR GS (1987). NEMATICIDE ALTERNATIVES FOR CONNECTICUT USA CIGAR TOBACCO. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY (NORTHEASTERN DIVISION), NOVEMBER 5-7, 1986. PHYTOPATHOLOGY;*

77 (1). 1987. 122.
Rejection Code: ABSTRACT.

106. THIES JA and FERY RL (1997). USE OF RESISTANT PEPPERS TO MANAGE SOUTHERN ROOT-KNOT NEMATODES COMPARISON OF HOST PLANT RESISTANCE AND METHYL BROMIDE SOIL FUMIGATION. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, ROCHESTER, NEW YORK, USA, AUGUST 9-13, 1997. PHYTOPATHOLOGY; 87* S96.
Rejection Code: ABSTRACT.

107. THORNTON RE , STEVENS RG, and HAMMOND MW (1993). SELECTING THE SITE AND PREPARING IT FOR PLANTING. *ROWE, R. C. (ED.). POTATO HEALTH MANAGEMENT. X+178P. AMERICAN PHYTOPATHOLOGICAL SOCIETY (APS) PRESS: ST. PAUL, MINNESOTA, USA. ISBN 0-89054-144-2.; 0 (0). 1993. 11-18.*
Rejection Code: NO TOX DATA.

108. Venkateswarlu, K. (1993). Pesticide Interactions with Cyanobacteria in Soil and Pure Culture. *In: J.M.Bollag and G.Stotzky (Eds.), Soil Biochemistry, Marcel Dekker Inc., New York, NY* 8: 137-179.
Rejection Code: REVIEW.

109. Wade, Elisabeth A., Reak, Kristina E., Parsons, Bradley F., Clemes, Thomas P., and Singmaster, Karen A. (2002). Photochemistry of chloropicrin in cryogenic matrices. *Chemical Physics Letters* 365: 473-479.
Rejection Code: CHEM METHODS.

110. WELKE, B., ETTLINGER, K., and RIEDERER, M. (1998). Sorption of volatile organic chemicals in plant surfaces. *ENVIRONMENTAL SCIENCE & TECHNOLOGY; 32* 1099-1104.
Rejection Code: FATE.

111. WHITEHEAD AG (1986). TECHNIQUES OF APPLYING NEMATICIDES TO SOIL. *VIITH CIRCUM-MEDITERRANEAN PLANT PROTECTION MEETING, KHANIA, GREECE, SEPT. 24-28, 1984. BULL OEPP (ORGAN EUR MEDITERR PROT PLANT); 16 (2). 1986. 335-342.*
Rejection Code: NO TOX DATA.

112. WILHELM SN and SHEPLER, K. (1995). ENVIRONMENTAL FATE OF CHLOROPICRIN. *210TH AMERICAN CHEMICAL SOCIETY NATIONAL MEETING, CHICAGO, ILLINOIS, USA, AUGUST 20-24, 1995. ABSTRACTS OF PAPERS AMERICAN CHEMICAL SOCIETY; 210* AGRO 76.
Rejection Code: ABSTRACT,FATE.

113. WILLIAMS DT , LEBEL GL, and BENOIT FM (1997). Disinfection by-products in Canadian drinking water. *CHEMOSPHERE; 34* 299-316.
Rejection Code: EFFLUENT.

114. WORTHING CR (1991). THE PESTICIDE MANUAL A WORLD COMPENDIUM 9TH EDITION. *WORTHING, C. R. (ED.). THE PESTICIDE MANUAL: A WORLD COMPENDIUM, 9TH EDITION. XLVII+1141P. BRITISH CROP PROTECTION COUNCIL: FARNHAM, ENGLAND, UK. ILLUS. ISBN 0-948404-42-6.; 0 (0). 1991. XLVII+1141P.*
Rejection Code: NO TOX DATA.

115. WU WW, CHADIK PA, DAVIS WM, POWELL DH, and DELFINO JJ (1998). Disinfection

byproduct formation from the preparation of instant tea. *JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY; 46* 3272-3279 .
Rejection Code: NO TOX DATA.

116. XIAO CL and DUNIWAY JM (1998). BACTERIAL POPULATION RESPONSES TO SOIL FUMIGATION AND THEIR EFFECTS ON STRAWBERRY GROWTH. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, LAS VEGAS, NEVADA, USA, NOVEMBER 8-12, 1998. PHYTOPATHOLOGY; 88* S100.
Rejection Code: ABSTRACT.

117. YOSHIDA, M. , IKEDA, T., IWASAKI, M., TSUDA, S., and SHIRASU, Y. (1987). ACUTE INHALATION TOXICITY OF CHLOROPICRIN VAPOR IN RATS. *J PESTIC SCI; 12* 237-244.
Rejection Code: INHALE.

118. YOSHIDA, M. , MURAO, N., TSUDA, S., and SHIRASU, Y. (1991). Effects of mode of exposure on acute inhalation toxicity of chloropicrin vapor in rats. *J PESTIC SCI; 16* 63-70.
Rejection Code: INHALE.

119. YUEN GY, SCHROTH MN, HANCOCK JG, and WEINHOLD AR (1988). DIFFERENTIAL EFFECTS OF VARIOUS PREPLANT SOIL TREATMENTS ON THE ROOT FUNGAL MICROFLORA ROOT GROWTH AND YIELD OF STRAWBERRY. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY AND THE PACIFIC DIVISION, SAN DIEGO, CALIFORNIA, USA, NOVEMBER 13-17, 1988. PHYTOPATHOLOGY; 78* 1545.
Rejection Code: ABSTRACT.

120. Zhang, Guangming and Hua, Inez (2000). Ultrasonic degradation of trichloroacetonitrile, chloropicrin and bromobenzene: design factors and matrix effects. *Advances in Environmental Research* 4: 219-224.
Rejection Code: CHEM METHODS.

121. Zheng, Wei, Papiernik, Sharon K, Guo, Minxing, and Yates, Scott R (Competitive degradation between the fumigants chloropicrin and 1,3-dichloropropene in unamended and amended soils. *Journal Of Environmental Quality* 32: 1735-1742.
Rejection Code: FATE.

122. Zheng, Wei, Yates, Scott R, Guo, Mingxin, Papiernik, Sharon K, and Kim, Jung Ho (2004). Transformation of chloropicrin and 1,3-dichloropropene by metam sodium in a combined application of fumigants. *Journal Of Agricultural And Food Chemistry* 52: 3002-3009.
Rejection Code: FATE.

123. Zheng, Wei, Yates, Scott R, Papiernik, Sharon K, and Guo, Mingxin (Effect of combined application of methyl isothiocyanate and chloropicrin on their transformation. *Journal Of Environmental Quality* 33: 2157-2164.
Rejection Code: FATE.

1. 1987). LABORATORY VOLATILITY STUDY WITH METHYL BROMIDE AND CHLOROPICRIN WITH ATTACHMENTS. *EPA/OTS; Doc #86-870000924*.
Rejection Code: NO SPECIES.

2. 2000). TELONE C-17 SOIL FUNGICIDE AND NEMATICIDE: ACUTE ORAL TOXICITY STUDY IN FISCHER 344 RATS (FINAL REPORT) WITH COVER LETTER DATED 102688. *EPA/OTS; Doc #86-890000016*.
Rejection Code: HUMAN HEALTH.

3. 2000). TELONE C-17 SOIL FUNGICIDE AND NEMATICIDE: DERMAL SENSITIZATION POTENTIAL IN THE HARTLEY ALBINO GUINEA PIG WITH ATTACHMENTS AND COVER LETTER DATED 091388. *EPA/OTS; Doc #86-880000357*.
Rejection Code: HUMAN HEALTH.

4. 2000). TELONE C-17 SOIL FUNGICIDE AND NEMATICIDE: PRIMARY DERMAL IRRITATION STUDY IN NEW ZEALAND WHITE RABBITS (FINAL REPORT) WITH COVER LETTER DATED 092688. *EPA/OTS; Doc #86-890000001*.
Rejection Code: HUMAN HEALTH.

5. 1988). TELONE C-17 SOIL FUNGICIDE AND NEMATOCIDE: A ONE HOUR ACUTE VAPOR INHALATION STUDY IN FISCHER 344 RATS WITH COVER LETTER DATED 121588. *EPA/OTS; Doc #86-890000062*.
Rejection Code: INHALE.

6. 1981). TSCA SECTION 8(E) REPORT-CHLOROPICRIN LEAK AT BERTH 24-PORT OF LONG BEACH, CALIFORNIA ON AUGUST 18, 1981 WITH EPA RESPONSE DATED 102181. *EPA/OTS; Doc #88-8100284*.
Rejection Code: INCIDENT.

7. Ajwa, H. A. and Trout, T. (Drip application of alternative fumigants to methyl bromide for strawberry production. *HortScience, 39 (7) pp. 1707-1715, 2004*.
Rejection Code: NO TOX DATA.

8. Aldrich, D. G. and Martin, J. P. (1952). Effect of Fumigation on Some Chemical Properties of Soils. *Calif.Citogr.* 37: 392,412-415.
Rejection Code: FATE.

9. Anderson, R. C. and Liberta, A. E. (1992). Influence of Supplemental Inorganic Nutrients on Growth, Survivorship, and Mycorrhizal Relationships of Schizachyrium scoparium (Poaceae) Grown in Fumigated and Unfumigated Soil. *Am.J.Bot.* 79: 406-414.
Rejection Code: MIXTURE.

10. ANON (1988). A MASSIVE FUMIGATION. *PEST CONTROL; 56* 48-50.
Rejection Code: NO SOURCE.

11. AUGER, J., BIRKETT MA, COATS, J., COHEN SZ, HAWKES TR, LUCCA, P., NARAYANAN KS, POTRYKUS, I., and ROBERTSON, A. (1998). All specialisations were catered for at the IUPAC conference (London, UK: August, 1998; IUPAC). *INTERNATIONAL PEST CONTROL; 40* 204-207.
Rejection Code: REVIEW.

12. Austerweil, M., Steiner, B., and Gamliel, A. (2006). Permeation of Soil Fumigants Through Agricultural Plastic Films. *Phytoparasitica, 34 (5) pp. 491-501, 2006*.
Rejection Code: CHEM METHODS.

13. Barker, K. R. and Powell, N. T. (1988). Influence of Aldicarb on the Growth and Yield of Tobacco. *J.Nematol.* 20: 432-438.

14. Baxter, P. (1977). Orchard Soil Management Trials. 3. Effect of Soil Fumigation and Soil Management on Replanted Apple Trees. *Aust.J.Exp.Agric.Anim.Husb.* 17: 510-514.

15. BEAVIS, C., SIMPSON, P., SYME, J., and RYAN, C. (1991). QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES INFORMATION SERIES QI91006. INFOPEST CHEMICALS FOR THE PROTECTION OF FIELD CROPS FORAGE CROPS AND PASTURES 2ND EDITION. *BEAVIS, C., P. SIMPSON, J. SYME AND C. RYAN. QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES INFORMATION SERIES, QI91006. INFOPEST: CHEMICALS FOR THE PROTECTION OF FIELD CROPS, FORAGE CROPS AND PASTURES, 2ND EDITION. VI+312P. QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES: BRISBANE, QUEENSLAND, AUSTRALIA. PAPER. ISBN 0-7242-3985-5.; 0* VI+312P.
Rejection Code: NO TOX DATA.

16. Benliog(caron)lu, S., Boz O(dieresis), Yildiz, A., Kas(cedilla)kavalci, G., and Benliog(caron)lu, K. (2005). Alternative Soil Solarization Treatments for the Control of Soil-Borne Diseases and Weeds of Strawberry in the Western Anatolia of Turkey. *Journal of Phytopathology, 153 (7-8) pp. 423-430, 2005*.
Rejection Code: METHODS.

17. BOLLAG J-M and LIU S-Y (1990). BIOLOGICAL TRANSFORMATION PROCESSES OF PESTICIDES. *CHENG, H. H. (ED.). SSSA (SOIL SCIENCE SOCIETY OF AMERICA) BOOK SERIES, NO. 2. PESTICIDES IN THE SOIL ENVIRONMENT: PROCESSES, IMPACTS, AND MODELING. XXIII+530P. SOIL SCIENCE SOCIETY OF AMERICA, INC.: MADISON, WISCONSIN, USA. ILLUS. ISBN 0-89118-791-X.; 0 (0). 1990. 169-212.*
Rejection Code: METABOLISM.

18. BRUST GE and SCOTT WD (1994). COMPARING THE EFFICACY OF CHEMICAL CONTROLS FOR ROOT-KNOT NEMATODE ON WATERMELON. *91ST ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, CORVALLIS, OREGON, USA, AUGUST 7-10, 1994. HORTSCIENCE; 29 (5). 1994. 471. AB - BIOSIS COPYRIGHT: BIOL ABS. RRM ABSTRACTS ONLY MELOIDOGYNE-SPP INVERTEBRATE PLANT HORTICULTURE METHAM SODIUM METHYL BROMIDE CHLOROPICRIN OXAMYL FOSTHIAZATE PESTICIDE YIELD*.
Rejection Code: ABSTRACT.

19. Buckley, L. A., Jiang, X. Z., James, R. A., Morgan, K. T., and Barrow, C. S. (1984). Respiratory tract lesions induced by sensory irritants at the RD50 concentration. *Toxicology and Applied Pharmacology [TOXICOL. APPL. PHARMACOL.]* 74: 417-429.
Rejection Code: HUMAN HEALTH.

20. Bull, C. T., Shetty, K. G., and Subbarao, K. V. (Interactions between myxobacteria, plant pathogenic fungi, and biocontrol agents. *Plant Disease, 86 (8) pp. 889-896, 2002*.
Rejection Code: BACTERIA.

21. Burkhart, K. K. (2005). Fumigant Toxicity: Much to Study. *Clinical Toxicology [Clin. Toxicol.]. Vol. 43, no. 5, p. 426. 2005.*
Rejection Code: HUMAN HEALTH.

22. Castro, C. E., Yokoyama, W., and Belser, N. O. (1989). Biodehalogenation: Active site versus enzymatic and whole cell rates with cytochromes P-450. *Environmental Toxicology and Chemistry [ENVIRON. TOXICOL. CHEM.]* 8: 13-18.
Rejection Code: IN VITRO.

23. CASTRO CE, YOKOYAMA, W., and BELSER NO (1987). BIODEHALOGENATION COMPARATIVE REACTIVITIES OF CYTOCHROMES P-450 WITH HEME AND WHOLE CELL MODELS. *193RD AMERICAN CHEMICAL SOCIETY NATIONAL MEETING, DENVER, COLORADO, USA, APRIL 5-10, 1987. ABSTR PAP AM CHEM SOC; 193* NO PAGINATION.
Rejection Code: ABSTRACT.

24. Cervini-Silva, J, Larson, R A, Wu, J, and Stucki, J W (2001). Transformation of chlorinated aliphatic compounds by ferruginous smectite. *Environmental Science & Technology* 35: 805-809.
Rejection Code: FATE.

25. Chandler, C. K., Legard, D. E., and Noling, J. W. (Performance of strawberry cultivars on fumigated and nonfumigated soil in Florida. *HortTechnology, 11 (1) pp. 69-71, 2001*.
Rejection Code: NO TOX DATA.

26. Chellemi, D. O. (2006). Effect of Urban Plant Debris and Soil Management Practices on Plant Parasitic Nematodes, Phytophthora Blight and Pythium Root Rot of Bell Pepper. *Crop Prot.* 25: 1109-1116.
Rejection Code: MIXTURE.

27. Chellemi, D. O., Olson, S. M., Mitchell, D. J., Secker, I., and McSorley, R. (Adaptation of soil solarization to the integrated management of soilborne pests of tomato under humid conditions. *Phytopathology, 87 (3) pp. 250-258, 1997*.
Rejection Code: METHODS.

28. CHEN WJ and WEISEL CP (1998). Halogenated DBP concentrations in a distribution system. *AMERICAN WATER WORKS ASSOCIATION JOURNAL; 90* 151-163.
Rejection Code: EFFLUENT.

29. Coelho, L., Chellemi, D. O., and Mitchell, D. J. (Efficacy of solarization and cabbage amendment for the control of Phytophthora spp. in North Florida. *Plant Disease, 83 (3) pp. 293-299, 1999*.
Rejection Code: METHODS.

30. COHEN, S., SVRJCEK, A., DURBOROW, T., and BARNES NL (1999). Water quality impacts by golf courses. *JOURNAL OF ENVIRONMENTAL QUALITY; 28* 798-809.
Rejection Code: REVIEW.

31. Daft, J. (1987). Determining multifumigants in whole grains and legumes, milled and low-fat grain products, spices, citrus fruit, and beverages. *Journal of the Association of Official Analytical Chemists [J. ASSOC. OFF. ANAL. CHEM.]* 70: 734-739.
Rejection Code: NO TOXICANT.

32. DAFT JL (1989). DETERMINATION OF FUMIGANTS AND RELATED CHEMICALS IN

FATTY AND NONFATTY FOODS. *J AGRIC FOOD CHEM; 37* 560-564.
Rejection Code: HUMAN HEALTH.

33. De Cal, A., Martinez-Trecen(tilde)o, A., Lopez-Aranda, J. M., and Melgarejo, P. (Chemical alternatives to methyl bromide in spanish strawberry nurseries. *Plant Disease, 88 (2) pp. 210-214, 2004*.
Rejection Code: METHODS.

34. Desaeger, J. A. J., Eger, J. r. JE, Csinos, A. S., Gilreath, J. P., Olson, S. M., and Webster, T. M. (Movement and biological activity of drip-applied 1,3-dichloropropene and chloropicrin in raised mulched beds in the southeastern USA. *Pest Management Science, 60 (12) pp. 1220-1230, 2004*.
Rejection Code: FATE.

35. Desaeger, Johan Aj, Eger, Joe E Jr, Csinos, Alex S, Gilreath, James P, Olson, Steve M, and Webster, Theodore M (2004). Movement and biological activity of drip-applied 1,3-dichloropropene and chloropicrin in raised mulched beds in the southeastern USA. *Pest Management Science* 60: 1220-1230.
Rejection Code: FATE.

36. DICKSON DW (1997). ALTERNATIVES TO METHYL BROMIDE FOR CONTROL OF NEMATODE AND SOILBORNE DISEASES. *36TH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS, TUCSON, ARIZONA, USA, JULY 19-23, 1997. JOURNAL OF NEMATOLOGY* 29: 575.
Rejection Code: ABSTRACT.

37. DOLL CC and RIES SM (1986). FUMIGATION OF PEACH REPLANT SITES. *XXII INTERNATIONAL HORTICULTURAL CONGRESS HELD AT THE 83RD ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, DAVIS, CALIF., USA, AUG. 10-18, 1986. HORTSCIENCE; 21* 776.
Rejection Code: ABSTRACT.

38. DUGUET JP, TSUTSUMI, Y., BRUCHET, A., and MALLEVIALLE, J. (1985). CHLOROPICRIN IN POTABLE WATER CONDITIONS OF FORMATION AND PRODUCTION DURING TREATMENT PROCESSES. *JOLLEY, R. L. ET AL. (ED.). WATER CHLORINATION, VOL. 5. CHEMISTRY, ENVIRONMENTAL IMPACT AND HEALTH EFFECTS. FIFTH CONFERENCE ON WATER CHLORINATION: ENVIRONMENTAL IMPACT AND HEALTH EFFECTS, WILLIAMSBURG, VA., USA, JUNE 3-8, 1984. XX+1575P. LEWIS PUBLISHERS, INC.: CHELSEA, MICH., USA. ILLUS. MAPS. ISBN 0-87371-005-3.; 0 (0). 1985. 1201-1214.*
Rejection Code: EFFLUENT.

39. Duniway, J. M. (Status of chemical alternatives to methyl bromide for pre-plant fumigation of soil. *Phytopathology, 92 (12) pp. 1337-1343, 2002*.
Rejection Code: NO TOX DATA.

40. Ebbels, D. L. (1970). Effect of Fumigants on Fungi in Buried Wheat Straw. *Trans.Br.Mycol.Soc.* 54: 227-232.

41. ENGELBRECHT MC, VAN WYK RJ, ENGELBRECHT, S. LG, and VAN RENSBURG J NJ (1990). Control of bacterial wilt of tobacco with chloropicrin in South Africa. *PHYTOPHYLACTICA; 22* 269-271.

Rejection Code: BACTERIA.

42. ESTES EA, SKROCH WA, KONSLER TR, SHOEMAKER PB, and SORENSEN KA (1985). NET ECONOMIC VALUES OF EIGHT SOIL MANAGEMENT PRACTICES USED IN STAKE TOMATO LYCOPERSICON-ESCULENTUM PRODUCTION. *J AM SOC HORTIC SCI; 110* 812-816.
Rejection Code: NO TOX DATA.

43. Fennimore, S. A., Haar, M. J., and Ajwa, H. A. (Weed control in strawberry provided by shank- and drip-applied methyl bromide alternative fumigants. *HortScience, 38 (1) pp. 55-61, 2003*.
Rejection Code: METHODS.

44. Fort, S. B. and Shaw, D. V. (Genetic analysis of strawberry root system traits in fumigated and nonfumigated soils I. Inheritance patterns of strawberry root system characteristics. *Journal of the American Society for Horticultural Science, 125 (3) pp. 318-323, 2000*.
Rejection Code: NO TOX DATA.

45. Fort, S. B. and Shaw, D. V. (Genetic analysis of strawberry root system traits in fumigated and nonfumigated soils II. Relationships among root system and above-ground traits of strawberry seedlings. *Journal of the American Society for Horticultural Science, 125 (3) pp. 324-329, 2000*.
Rejection Code: NO TOX DATA.

46. Fort, S. B. and Shaw, D. V. (Phenotypic correlations between root and shoot traits of strawberry in fumigated and nonfumigated soils. *HortScience, 33 (2) pp. 222-224, 1998*.
Rejection Code: MIXTURE.

47. FORT SB and SHAW DV (1998). Phenotypic correlations between root and shoot traits of strawberry in fumigated nonfumigated soils. *HORTSCIENCE; 33* 222-224.
Rejection Code: MIXTURE.

48. FORT SB, SHAW DV, and LARSON KD (1996). Performance responses of strawberry seedlings to the sublethal effects of nonfumigated soils. *JOURNAL OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE; 121* 367-370.
Rejection Code: MIXTURE.

49. FORTNUM BA, GOODEN DT, CURRIN, R. E. III, and MARTIN SB (1989). SPRING OR FALL FUMIGATION FOR CONTROL OF MELOIDOGYNE-SPP ON TOBACCO. *TWENTY-EIGHTH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS, DAVIS, CALIFORNIA, USA, AUGUST 13-17, 1989. J NEMATOL; 21* 561.
Rejection Code: ABSTRACT.

50. FORTNUM BA and PULLEN MP (1992). CONTROL OF ROOT-KNOT DISEASE COMPLEXES ON FLUE-CURED TOBACCO WITH SOIL FUMIGATION AND PLASTIC MULCH. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, PORTLAND, OREGON, USA, AUGUST 8-12, 1992. PHYTOPATHOLOGY; 82* 1096.
Rejection Code: ABSTRACT.

51. Fraedrich, S. W. and Dwinell, L. D. (2003). An Evaluation of Dazomet Incorporation Methods on Soilborne Organisms and Pine Seedling Production in Southern Nurseries. *South.J.Appl.For.* 27: 41-51.

52. GERBA CP (1996). MUNICIPAL WASTE AND DRINKING WATER TREATMENT. *PEPPER,*

I. L., C. P. GERBA AND M. L. BRUSSEAU (ED.). POLLUTION SCIENCE. XXIV+397P. ACADEMIC PRESS, INC.: SAN DIEGO, CALIFORNIA, USA; LONDON, ENGLAND, UK. ISBN 0-12-550660-0.; 0 (0). 1996. 301-319.
Rejection Code: EFFLUENT.

53. Gilreath, J. P., Motis, T. N., and Santos, B. M. (2005). Cyperus spp. Control with Reduced Methyl Bromide plus Chloropicrin Doses Under Virtually Impermeable Films in Pepper. *Crop Prot.* 24: 285-287.
Rejection Code: MIXTURE.

54. Gilreath, J. P., Motis, T. N., and Santos, B. M. (2005). Cyperus Spp. Control With Reduced Methyl Bromide Plus Chloropicrin Doses Under Virtually Impermeable Films in Pepper. *Crop Protection, 24 (3) pp. 285-287, 2005.*
Rejection Code: METHODS.

55. Gilreath, J. P., Motis, T. N., Santos, B. M., Noling, J. W., Locascio, S. J., and Chellemi, D. O. (2005). Resurgence of Soilborne Pests in Double-Cropped Cucumber After Application of Methyl Bromide Chemical Alternatives and Solarization in Tomato. *HortTechnology, 15 (4) pp. 797-801, 2005.*
Rejection Code: MIXTURE.

56. Gilreath, J. P. and Santos, B. M. (2004). Methyl Bromide Alternatives for Weed and Soilborne Disease Management in Tomato (Lycopersicon esculentum). *Crop Prot.* 23: 1193-1198.

57. Gilreath, J. P., Santos, B. M., Chase, C. A., and Locascio, S. J. (2006). Influence of Soil Fumigation on 2,4-D and Dicamba Carryover in Fresh Market Tomato. *Crop Protection, 25 (10) pp. 1095-1100, 2006.*
Rejection Code: MIXTURE.

58. Gilreath, J. P., Santos, B. M., Gilreath, P. R., Jones, J. P., and Noling, J. W. (Efficacy of 1,3-dichloropropene plus chloropicrin application methods in combination with pebulate and napropamide in tomato. *Crop Protection, 23 (12) pp. 1187-1191, 2004.*

59. Gilreath, James P., Motis, Timothy N., and Santos, Bielinski M. (2005). Cyperus spp. control with reduced methyl bromide plus chloropicrin doses under virtually impermeable films in pepper. *Crop Protection* 24: 285-287.
Rejection Code: MIXTURE.

60. Gilreath, James P. and Santos, Bielinski M. (2004). Herbicide dose and incorporation depth in combination with 1,3-dichloropropene plus chloropicrin for Cyperus rotundus control in tomato and pepper. *Crop Protection* 23: 205-210.
Rejection Code: MIXTURE.

61. Golfinopoulos, Spyros K, Nikolaou, Anastasia D, and Lekkas, Themistokles D (2003). The occurrence of disinfection by-products in the drinking water of Athens, Greece. *Environmental Science And Pollution Research International* 10: 368-372.
Rejection Code: EFFLUENT.

62. Goodell, B., Hosli, J. P., and Kropp, B. (1987). The Diffusion and Toxicity of the Fumigant Chloropicrin Injected in Sugar Maple and White Birch Trees. *Can.J.For.Res.* 17: 1552-1556.

63. Gordon, T. R., Kirkpatrick, S. C., Shaw, D. V., and Larson, K. D. (Differential infection of mother and runner plant generations by Verticillium dahliae in a high elevation strawberry nursery. *HortScience, 37 (6) pp. 927-931, 2002.*
Rejection Code: MIXTURE.

64. GRAHAM JH, MCGUIRE RG, and MILLER JW (1987). SURVIVAL OF XANTHOMAS-CAMPESTRIS PATHOVAR CITRI IN CITRUS PLANT DEBRIS AND SOIL IN FLORIDA USA AND ARGENTINA. *PLANT DIS; 71* 1094-1098.
Rejection Code: SURVEY.

65. GRAY FA, KOCH DW, GERIK JS, and FISHER GA (1998). COMPARISON OF TWO SOIL FUMIGANTS FOR CONTROL OF FUSARIUM OXYSPORUM F.SP. BETAE AND HETERODERA SCHACHTII. *MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, PACIFIC DIVISION, FORT COLLINS, COLORADO, USA, JUNE 27-28, 1997. PHYTOPATHOLOGY; 88* S107.
Rejection Code: ABSTRACT.

66. Gullino, M. L., Minuto, A., Gilardi, G., Garibaldi, A., Ajwa, H., and Duafala, T. (Efficacy of preplant soil fumigation with chloropicrin for tomato production in Italy. *Crop Protection, 21 (9) pp. 741-749, 2002.*
Rejection Code: METHODS.

67. Gullino, M Lodovica, Minuto, Andrea, and Garibaldi, Angelo (2002). Soil fumigation with chloropicrin in Italy: experimental results on melon, eggplant and tomato. *Mededelingen (Rijksuniversiteit Te Gent. Fakulteit Van De Landbouwkundige En Toegepaste Biologische Wetenschappen)* 67: 171-180.
Rejection Code: FATE.

68. Guo, M., Papiernik, S. K., Zheng, W., and Yates, S. R. (Formation and extraction of persistent fumigant residues in soils. *Environmental Science and Technology, 37 (9) pp. 1844-1849, 2003.*
Rejection Code: FATE.

69. Guo, M., Yates, S. R., Papiernik, S. K., and Zheng, W. (2005). Incompatibility of Metam Sodium With Halogenated Fumigants. *Pest Management Science, 61 (5) pp. 467-476, 2005.*
Rejection Code: MIXTURE.

70. Guo, M., Yates, S. R., Zheng, W., and Papiernik, S. K. (Leaching Potential of Persistent Soil Fumigant Residues. *Environmental Science and Technology, 37 (22) pp. 5181-5185, 2003.*
Rejection Code: FATE.

71. Guo, Mingxin , Papiernik, Sharon K, Zheng, Wei, and Yates, Scott R (2003). Formation and extraction of persistent fumigant residues in soils. *Environmental Science & Technology* 37: 1844-1849.
Rejection Code: FATE.

72. Guo, Mingxin , Yates, Scott R, Zheng, Wei, and Papiernik, Sharon K (2003). Leaching potential of persistent soil fumigant residues. *Environmental Science & Technology* 37: 5181-5185.
Rejection Code: FATE.

73. Haji, H. M. and Brandle, J. E. (Evaluation of host resistance and soil fumigation for the management of black root rot of tobacco in Ontario. *Plant Disease, 85 (11) pp. 1145-1148,*

2001.
Rejection Code: MIXTURE.

74. HARRIS DC (1990). Control of verticillium wilt and other soil-borne diseases of strawberry in Britain by chemical soil disinfestation.
Rejection Code: NO SOURCE.

75. HARRIS DC (1989). THE USE OF SOIL STERILANTS FOR CONTROLLING VERTICILLIUM WILT OF STRAWBERRY IN BRITAIN UK. *THIRD INTERNATIONAL SYMPOSIUM ON SOIL DISINFESTATION, LEUVEN, BELGIUM, SEPTEMBER 26-30, 1988. ACTA HORTIC (WAGENINGEN); 0 (255). 1989. 100.*
Rejection Code: REVIEW.

76. HARTZ TK, DEVAY JE, and ELMORE CL (1993). Solarization is an effective soil disinfestation technique for strawberry production. *HORTSCIENCE; 28* 104-106.
Rejection Code: NO TOX DATA.

77. HARTZ TK, HOLT DB, and DEVAY JE (1991). SOIL SOLARIZATION EFFECTIVE AS A SOIL DISINFESTATION TECHNIQUE FOR STRAWBERRY PRODUCTION. *88TH ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, UNIVERSITY PARK, PENNSYLVANIA, USA, JULY 19-24, 1991. HORTSCIENCE; 26* 792.
Rejection Code: REVIEW.

78. HEALD CM (1989). CONTROL OF MELOIDOGYNE-HAPLA INFECTING ROSES. *TWENTY-EIGHTH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS, DAVIS, CALIFORNIA, USA, AUGUST 13-17, 1989. J NEMATOL; 21* 564-565.
Rejection Code: ABSTRACT.

79. HIMELRICK DG , WOODS FM, and DOZIER, W. A. JR (1995). EFFECT OF SOIL FUMIGATION AND SOIL SOLARIZATION ON ANNUAL HILL STRAWBERRY PRODUCTION. *92ND ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE AND THE 40TH ANNUAL CONGRESS OF THE CANADIAN SOCIETY FOR HORTICULTURAL SCIENCE, MONTREAL, QUEBEC, CANADA, JULY 30-AUGUST 3, 1995. HORTSCIENCE; 30* 800.
Rejection Code: ABSTRACT.

80. HOLLIGER, C. and SCHRAA, G. (1994). PHYSIOLOGICAL MEANING AND POTENTIAL FOR APPLICATION OF REDUCTIVE DECHLORINATION BY ANAEROBIC BACTERIA. *FEMS MICROBIOLOGY REVIEWS; 15* 297-305.
Rejection Code: BACTERIA.

81. Hoshino, Yuko Takada and Matsumoto, Naoyuki (2007). Dna- Versus Rna-Based Denaturing Gradient Gel Electrophoresis Profiles of a Bacterial Community During Replenishment After Soil Fumigation. *Soil Biology and Biochemistry* 39: 434-444.
Rejection Code: BACTERIA.

82. Hutchinson, C. M., McGiffen, J. r. ME, Sims, J. J., and Becker, J. O. (Fumigant combinations for Cyperus esculentum L control. *Pest Management Science, 60 (4) pp. 369-374, 2004.*
Rejection Code: MIXTURE.

83. Hutchinson, C. M., McGiffen, M. E. Jr., Ohr, H. D., Sims, J. J., and Becker, J. O. (2000). Efficacy of Methyl Iodide and Synergy with Chloropicrin for Control of Fungi. *Pest Manag.Sci.* 56: 413-418.

84. Hutchinson, Chad M, McGiffen, Milton E Jr, Sims, James J, and Becker, J Ole (2004). Fumigant combinations for Cyperus esculentum L control. *Pest Management Science* 60: 369-374.
Rejection Code: MIXTURE.

85. Ibekwe, A M, Papiernik, S K, Gan, J, Yates, S R, Yang, C H, and Crowley, D E (2001). Impact of fumigants on soil microbial communities. *Applied And Environmental Microbiology* 67: 3245-3257.
Rejection Code: BACTERIA.

86. Ingham, E. R. and Thies, W. G. (1997). Changes in Rhizosphere Microflora and Microfauna 10 Years Following Douglas-Fir Live Tree Injection with Chloropicrin or Methylisothiocyanate. *Can.J.For.Res.* 27: 724-731.
Rejection Code: NO CONC.

87. Ivanova-Alexandrovskaia, Z. V. (1941). Influence of Chlorpicrin on Germination of Seeds of Cotton. *Dok Vses Ak* 1941: 24-26.
Rejection Code: NON-ENGLISH.

88. IWASAKI, M., YOSHIDA, M., IKEDA, T., TSUDA, S., and SHIRASU, Y. (1985). COMPARISON OF WHOLE BODY EXPOSURE VS. SNOUT ONLY EXPOSURE IN INHALATION TOXICITY. *21ST ANNUAL MEETING OF THE JAPANESE SOCIETY OF TOXICOLOGICAL SCIENCES, TOKYO, JAPAN, JULY 1-2, 1985. J TOXICOL SCI; 10* 257.
Rejection Code: INHALE.

89. Johnson, A. W., Jaworski, C. A., Glaze, N. C., Sumner, D. R., and Chalfant, R. B. (1981). Effects of Film Mulch and Soil Pesticides on Nematodes, Weeds, and Yields of Vegetable Crops. *J.Nematol.* 13: 141-148.

90. JUUTI, S., VARTIANINEN, T., JOUTSENOJA, P., and RUUSKANEN, J. (1996). Volatile organochlorine compounds formed in the bleaching of pulp with ClO2. *CHEMOSPHERE; 33* 437-448.
Rejection Code: EFFLUENT.

91. Juzwik, J. and Rugg, D. J. (1996). Seedling Mortality and Development of Root Rot in White Pine Seedlings in Two Bare-Root Nurseries. *Can.J.Plant Pathol.* 18: 335-341.

92. Kabir, Z., Fennimore, S. A., Duniway, J. M., Martin, F. N. , Browne, G. T., Winterbottom, C. Q., Ajwa, H. A., Westerdahl, B. B., Goodhue, R. E., and Haar, M. J. (2005). Alternatives to Methyl Bromide for Strawberry Runner Plant Production. *HortScience, 40 (6) pp. 1709-1715, 2005*.
Rejection Code: NO TOX DATA.

93. Kampioti, Adamantia A. and Stephanou, Euripides G. (2002). The impact of bromide on the formation of neutral and acidic disinfection by-products (DBPs) in Mediterranean chlorinated drinking water. *Water Research* 36: 2596-2606.
Rejection Code: EFFLEUNT.

94. Kim, Jung-Ho , Gan, Jianying, Farmer, Walter J, Yates, Scott R, Papiernik, Sharon K, and Dungan, Robert S (2003). Organic matter effects on phase partition of 1,3-dichloropropene in soil.

Journal Of Agricultural And Food Chemistry 51: 165-169.
Rejection Code: FATE.

95. Klose, S. and Ajwa, H. A. (Enzyme activities in agricultural soils fumigated with methyl bromide alternatives. *Soil Biology and Biochemistry, 36 (10) pp. 1625-1635, 2004.*

96. Klose, Susanne and Ajwa, Husein A. (2004). Enzyme activities in agricultural soils fumigated with methyl bromide alternatives. *Soil Biology and Biochemistry* 36: 1625-1635.
Rejection Code: BACTERIA.

97. Knight, K. L. (1940). Fumigation of Sacked Grain with Chloropicrin. *J.Econ.Entomol.* 33: 536-539.

98. Koenning, S. R., Bailey, J. E., Schmitt, D. P., and Barker, K. R. (1998). Management of Plant-Parasitic Nematodes on Peanut with Selected Nematicides in North Carolina. *J.Nematol.* 30: 643-650 .

99. KRISHNAN, K. , PATERSON, J., and WILLIAMS DT (1997). Health risk assessment of drinking water contaminants in Canada: The applicability of mixture risk assessment methods. *REGULATORY TOXICOLOGY AND PHARMACOLOGY; 26* 179-187.
Rejection Code: EFFLUENT.

100. Kutywayo, V. (2003). Chemical Alternatives for Soil Fumigation with Methyl Bromide on Tobacco Seedbeds in Nematode and Weed Control. *Commun.Appl.Biol.Sci.Ghent Univ.* 68: 115-122.

101. LaMondia, J. A., Cowles, R. S., and Los, L. (2005). Prevalence and Potential Impact of Soil-Dwelling Pests and Insect Pathogenic Nematodes in Strawberry Fields. *HortScience, 40 (5) pp. 1366-1370, 2005*.
Rejection Code: SURVEY.

102. LANIEWSKI, K., BOREN, H., and GRIMVALL, A. (1998). Identification of volatile and extractable chloroorganics in rain and snow. *ENVIRONMENTAL SCIENCE & TECHNOLOGY; 32* 3935-3940.
Rejection Code: SURVEY.

103. Larson, K. D. and Shaw, D. V. (Soil fumigation and runner plant production: A synthesis of four years trials of strawberry nursery field. *HortScience, 35 (4) pp. 642-646, 2000.*
Rejection Code: NO TOX DATA.

104. Larson, K. D. and Shaw, D. V. (Soil fumigation, fruit production, and dry matter partitioning of field- grown strawberry plants. *Journal of the American Society for Horticultural Science, 121 (6) pp. 1137-1140, 1996*.
Rejection Code: MIXTURE.

105. LARSON KD (1994). NURSERY SOIL FUMIGATION TREATMENT STOLON PRODUCTION AND SUBSEQUENT GROWTH OF STRAWBERRY PLANTS IN CALIFORNIA. *91ST ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, CORVALLIS, OREGON, USA, AUGUST 7-10, 1994. HORTSCIENCE; 29 (5). 1994. 453. AB - BIOSIS COPYRIGHT: BIOL ABS. RRM ABSTRACTS ONLY CULTIVAR CHANDLER CULTIVAR SELVA PLANT HORTICULTURE GENERAL PESTICIDE CHLOROPICRIN*

METHYL BROMIDE PEST CONTROL DISEASE CONTROL RUNNER PRODUCTION VIGOR NEGATIVE CULTIVAR EFFECTS USA.
Rejection Code: ABSTRACT.

106. LARSON KD and SHAW DV (1994). PERFORMANCE OF TWELVE STRAWBERRY GENOTYPES IN FUMIGATED AND NONFUMIGATED SOIL. *91ST ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, CORVALLIS, OREGON, USA, AUGUST 7-10, 1994. HORTSCIENCE; 29 (5). 1994. 429. AB - BIOSIS COPYRIGHT: BIOL ABS. RRM ABSTRACTS ONLY FRAGARIA-ANANASSA PATHOGENS SOIL ORGANISM PLANT HORTICULTURE GENETICS YIELD PRODUCTIVITY SOIL FUMIGATION METHYL BROMIDE CHLOROPICRIN.*
Rejection Code: ABSTRACT.

107. LARSON KD and SHAW DV (1996). Soil fumigation, fruit production, and dry matter partitioning of field grown-strawberry plants. *JOURNAL OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE; 121* 1137-1140.
Rejection Code: MIXTURE.

108. LARSON KD, SHAW DV, and STERRETT, J. (1995). YIELD AND DRY MATTER PARTITIONING OF STRAWBERRY PLANTS GROWN WITH THREE PREPLANT SOIL FUMIGATION TREATMENTS. *92ND ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE AND THE 40TH ANNUAL CONGRESS OF THE CANADIAN SOCIETY FOR HORTICULTURAL SCIENCE, MONTREAL, QUEBEC, CANADA, JULY 30-AUGUST 3, 1995. HORTSCIENCE; 30* 781.
Rejection Code: ABSTRACT.

109. LEBEL GL, BENOIT FM, and WILLIAMS DT (1997). A one-year survey of halogenated disinfection by-products in the distribution system of treatment plants using three different disinfection processes. *CHEMOSPHERE; 34* 2301-2317.
Rejection Code: EFFLUENT.

110. Lee, K J, Kim, B H, Hong, J E, Pyo, H S, Park, S J, and Lee, D W (2001). A study on the distribution of chlorination by-products (CBPs) in treated water in Korea. *Water Research* 35: 2861-2872.
Rejection Code: EFFLUENT.

111. Lee, S., McLaughlin, R., Harnly, M., Gunier, R., and Kreutzer, R. (Community Exposures to Airborne Agricultural Pesticides in California: Ranking of Inhalation Risks. *Environmental Health Perspectives [Environ. Health Perspect.]. Vol. 110, no. 12, pp. 1175-1184. Dec 2002.*
Rejection Code: HUMAN HEALTH.

112. Locascio, S. J., Gilreath, J. P., Dickson, D. W., Kucharek, T. A., Jones, J. P., and Noling, J. W. (Fumigant alternatives to methyl bromide for polyethylene-mulched tomato. *HortScience, 32 (7) pp. 1208-1211, 1997.*
Rejection Code: METHODS.

113. LOCASCIO SJ and DICKSON DW (1998). METAM SODIUM COMBINED WITH CHLOROPICRIN AS AN ALTERNATIVE TO METHYL BROMIDE FUMIGATION FOR TOMATO. *95TH ANNUAL INTERNATIONAL CONFERENCE OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, CHARLOTTE, NORTH CAROLINA, JULY 12-15, 1998. HORTSCIENCE; 33* 524-525.
Rejection Code: ABSTRACT.

114. LOCASCIO SJ , GILREATH JP, DICKSON DW, KUCHAREK TA, JONES JP, and NOLING JW (1996). FUMIGANT ALTERNATIVES TO METHYL BROMIDE FOR POLYETHYLENE-MULCHED TOMATO. *93RD ANNUAL CONFERENCE OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, LEXINGTON, KENTUCKY, USA, OCTOBER 6-10, 1996. HORTSCIENCE; 31* 568.
Rejection Code: ABSTRACT.

115. MacLeod, W. J. and Sweetingham, M. W. (A root disease of Lupinus angustifolius caused by a new species of binucleate Rhizoctonia. *Australian Journal of Agriculture Research, 48 (1) pp. 21-30, 1997*.
Rejection Code: NO TOX DATA.

116. Marois, J. J. and Norcini, J. G. (2003). Survival of Black-Eyed Susan from Different Regional Seed Sources Under Low and High Input Systems. *Horttechnology* 13: 161-165.
Rejection Code: MIXTURE.

117. Martin, F. N. (Development of alternative strategies for management of soilborne pathogens currently controlled with methyl bromide. *Annual Review of Phytopathology, 41 (-) pp. 325-350, 2003*.
Rejection Code: METHODS.

118. Martin, F. N. and Bull, C. T. (Biological approaches for control of root pathogens of strawberry. *Phytopathology, 92 (12) pp. 1356-1362, 2002*.
Rejection Code: NO TOXICANT.

119. Martin, Frank N (2003). Development of alternative strategies for management of soilborne pathogens currently controlled with methyl bromide. *Annual Review Of Phytopathology* 41: 325-350.
Rejection Code: REVIEW.

120. MARTIN JK and KEMP JR (1986). THE MEASUREMENT OF CARBON TRANSFER WITHIN THE RHIZOSPHERE OF WHEAT GROWN IN FIELD PLOTS. *SOIL BIOL BIOCHEM; 18* 103-108.
Rejection Code: METABOLISM.

121. Mazor, M., Gazit, S., Reuven, G., and Efrat, H. (2003). Unattractiveness of Three Commercial Proteinaceous Fruit Fly Baits to Honey Bees. *Crop Prot.* 22: 995-997.

122. MCDONALD MR , KOOI, K. VANDER, and JANSE, S. (1999). Band fumigation improves carrot quality with reduced rates of fumigant. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, MONTREAL, QUEBEC, CANADA, AUGUST 7-11, 1999.YPHYTOPATHOLOGY; 89* S50.
Rejection Code: ABSTRACT.

123. McGovern, R. J., Vavrina, C. S., Noling, J. W., Datnof, L. A., and Yonce, H. D. (Evaluation of application methods of metam sodium for management of fusarium crown and root rot in tomato in southwest florida. *Plant Disease, 82 (8) pp. 919-923, 1998*.
Rejection Code: NO TOX DATA.

124. MEANS, E. G. III and KRASNER SW (1993). D-DBP REGULATION ISSUES AND RAMIFICATIONS. *AM WATER WORKS ASSOC J; 85* 68-73.
Rejection Code: EFFLUENT.

125. MELICHAR MW and ROBY DM (1995). TELONE SOIL FUMIGANTS REGULATORY AND RESEARCH UPDATE. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL ASSOCIATION, PITTSBURGH, PENNSYLVANIA, USA, AUGUST 12-16, 1995. PHYTOPATHOLOGY; 85* 1140.
Rejection Code: ABSTRACT.

126. MELTON TA (1996). USE OF NEMATICIDES FOR THREE CONTINUOUS YEARS TO CONTROL MELOIDOGYNE SPP. ON NICOTIANA TABACUM. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, NORTH CENTRAL DIVISION, INDIANAPOLIS, INDIANA, USA, JULY 27-31, 1996. PHYTOPATHOLOGY; 86* S2.
Rejection Code: ABSTRACT.

127. MENGE JA and NEMEC, S. (1997). CITRUS. *HILLOCKS, R. J. AND J. M. WALLER (ED.). SOILBORNE DISEASES OF TROPICAL CROPS. X+452P. CAB INTERNATIONAL: WALLINGFORD, ENGLAND, UK; NEW YORK, NEW YORK, USA. ISBN 0-85199-121-1.; 0 (0). 1997. 185-227.*
Rejection Code: NO TOX DATA.

128. MILLER LG, CONNELL TL, GUIDETTI JR, and OREMLAND RS (1997). Bacterial oxidation of methyl bromide in fumigated agricultural soils. *APPLIED AND ENVIRONMENTAL MICROBIOLOGY; 63* 4346-4354.
Rejection Code: METABOLISM.

129. Minuto, A., Gullino, M. L., Lamberti, F., D'Addabbo, T., Tescari, E., Ajwa, H., and Garibaldi, A. (2006). Application of an Emulsifiable Mixture of 1,3-Dichloropropene and Chloropicrin Against Root Knot Nematodes and Soilborne Fungi for Greenhouse Tomatoes in Italy. *Crop Protection, 25 (12) pp. 1244-1252, 2006.*

130. Moldenke, A. R. and Thies, W. G. (1996). Application of Chloropicrin to Control Laminated Root Rot: Research Design and Seasonal Dynamics of Control Populations of Soil Arthropods. *Environ.Entomol.* 25: 925-932.

131. MOORMAN TB (1989). A REVIEW OF PESTICIDE EFFECTS ON MICROORGANISMS AND MICROBIAL PROCESSES RELATED TO SOIL FERTILITY. *J PROD AGRIC; 2* 14-23.
Rejection Code: REVIEW.

132. Morrell, J. J., Forsyth, P. G., and Thies, W. G. (Distribution of methylisothiocyanate and chloropicrin in boles or roots of Douglas-fir trees. *Canadian Journal of Forest Research, 24 (12) pp. 2324-2329, 1994.*
Rejection Code: NO TOX DATA.

133. MORRELL JJ, FORSYTH PG, and THIES WG (1995). Distribution of methylisothiocyanate and chloropicrin in boles or roots of Douglas-fir trees. *CANADIAN JOURNAL OF FOREST RESEARCH; 24* 2324-2329.
Rejection Code: FATE.

134. MORRELL JJ and NEWBILL MA (1990). Movement of chloropicrin or methylisothiocyanate through the boles of Douglas-fir trees. *FOR SCI; 36* 192-195.
Rejection Code: FATE.

135. Moseby, K. E., De Jong, S., Munro, N., and Pieck, A. (2005). Home Range, Activity and Habitat Use of European Rabbits (Oryctolagus cuniculus) in Arid Australia: Implications for

Control. *Wildl.Res.* 32: 305-311.
Rejection Code: NO CONC.

136. MURAYAMA, T. (1987). JAPANESE PESTICIDES GUIDE. *MURAYAMA, T. (ED.). JAPANESE PESTICIDES GUIDE. XIV+223P. JAPAN PLANT PROTECTION ASSOCIATION: TOKYO, JAPAN. ILLUS. PAPER. ISBN 4-89051-000-1.; 0 (0). 1987. XIV+223P.*
Rejection Code: NO TOX DATA.

137. NAGANAWA, T., KYUMA, K., MORIYAMA, Y., YAMAMOTO, H., and TATSUYAMA, K. (1990). Changes of soil respiration after partial sterilization by autoclaving or addition of agrochemicals. *SOIL SCI PLANT NUTR; 36* 587-592.
Rejection Code: BACTERIA.

138. NELSON EE, GOLDFARB, B., and THIES WG (1987). TRICHODERMA SPECIES FROM FUMIGATED DOUGLAS-FIR ROOTS DECAYED BY PHELLINUS-WEIRII. *MYCOLOGIA; 79* 370-374.
Rejection Code: NO TOX DATA.

139. NELSON EE, THIES WG, and MCWILLIAMS MG (1995). Trichoderma spp. from roots of fumigated Douglas-fir trees infected with Phellinus weirii. *MYCOLOGIA; 87* 639-642.
Rejection Code: SURVEY.

140. Nelson, S. D., Locascio, S. J., Allen, J. r. LH, Dickson, D. W., and Mitchell, D. J. (Soil flooding and fumigant alternatives to methyl bromide in tomato and eggplant production. *HortScience, 37 (7) pp. 1057-1060, 2002.*
Rejection Code: MIXTURE.

141. Nelson, S. D., Riegel, C., Allen, L. H. Jr, Dickson, D. W., Gan, J., Locascio, S. J., and Mitchell, D. J. (Volatilization of 1,3-dichloropropene in Florida plasticulture and effects on fall squash production. *Journal of the American Society for Horticultural Science, 126 (4) pp. 496-502, 2001.*
Rejection Code: NO TOX DATA.

142. NIEMINSKI EC, CHAUDHURI, S., and LAMOREAUX, T. (1993). The occurrence of DBPs in Utah drinking waters. *AM WATER WORKS ASSOC J; 85* 98-105.
Rejection Code: EFFLUENT.

143. Nikolaou, Anastasia D, Golfinopoulos, Spyros K, and Lekkas, Themistokles D (2002). Formation of organic by-products during chlorination of natural waters. *Journal Of Environmental Monitoring: JEM* 4: 910-916.
Rejection Code: FATE.

144. NIRA, R., HASHIMOTO, T., MATSUZAKI, M., and NISHIMUNE, A. (1996). Nitrogen transformations and availability in soils with application of fumigants. *SOIL SCIENCE AND PLANT NUTRITION; 42* 261-268.
Rejection Code: NO SPECIES.

145. NISHIZAWA, T. (1999). MAJOR PLANT-PARASITIC NEMATODES AND THEIR CONTROL IN JAPANYJOURNAL ARTICLE NEMATODES PHYTOPARASITE PESTICIDES PEST MANAGEMENT PARASITOLOGY AGRICULTURE PEST CONTROL JAPAN PALEARCTIC REGION. *AGROCHEMICALS JAPAN; 0* 2-9.
Rejection Code: NO TOX DATA.

146. O'BRIEN RD and VAN BRUGGEN A HC (1990). Soil fumigation with dazomet and methyl

bromide for control of corky root of iceberg lettuce. *PLANT DIS; 74* 1022-1025.
Rejection Code: MIXTURE.

147. OLSON SM and NOLING JW (1994). EVALUATION OF ALTERNATIVE FUMIGANTS FOR TOMATO PRODUCTION. *91ST ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, CORVALLIS, OREGON, USA, AUGUST 7-10, 1994. HORTSCIENCE; 29 (5). 1994. 524. AB - BIOSIS COPYRIGHT: BIOL ABS. RRM MEETING ABSTRACT MEETING POSTER PLANT ROOT KNOT NEMATODE CONTROL INVERTEBRATE CROP INDUSTRY HORTICULTURE METHYLBROMIDE REPLACEMENT METHAM SODIUM DAZOMET 1 3-DICHLOROPROPENE CHLOROPICRIN*.
Rejection Code: ABSTRACT.

148. OU L-T (1998). Enhanced degradation of the volatile fumigant-nematicides 1,3-D and methyl bromide in soil. *JOURNAL OF NEMATOLOGY; 30* 56-64.
Rejection Code: FATE.

149. Overman, A. J., Csizinszky, A. A., Jones, J. P., and Stanley, C. D. (1987). Efficacy of Metam Sodium Applied via Drip Irrigation on Tomato. *Soil Crop Sci.Soc.Fla.Proc.:* 46: 4-7.

150. Papiernik, Sharon K and Yates, Scott R (2002). Effect of environmental conditions on the permeability of high density polyethylene film to fumigant vapors. *Environmental Science & Technology* 36: 1833-1838.
Rejection Code: NO TOX DATA.

151. Particka, C. A. and Hancock, J. F. (2005). Field Evaluation of Strawberry Genotypes for Tolerance to Black Root Rot on Fumigated and Nonfumigated Soil. *Journal of the American Society for Horticultural Science, 130 (5) pp. 688-693, 2005*.
Rejection Code: NO TOX DATA.

152. Peterson, C. J., Tsao, R., and Coats, J. R. (Naturally occurring cyanohydrins, analogues and derivatives as potential insecticides. *Pest Management Science, 56 (7) pp. 615-617, 2000*.
Rejection Code: NO TOX ICANT.

153. Peterson, C. J., Tsao Rong, and Coats, J. R. (Glucosinolate Aglucones and Analogues: Insecticidal Properties and a QSAR. *Pesticide Science [Pestic. Sci.]. Vol. 54, no. 1, pp. 35-42. Sep 1998.*
Rejection Code: NO TOXICANT.

154. PETERSON CJ and COATS JR (1998). NATURALLY OCCURRING FUMIGANT INSECTICIDES CYANOHYDRINS AND GLUCOSINOLATES. *216TH NATIONAL MEETING OF THE AMERICAN CHEMICAL SOCIETY, BOSTON, MASSACHUSETTS, USA, AUGUST 23-27, 1998. ABSTRACTS OF PAPERS AMERICAN CHEMICAL SOCIETY; 216* AGRO 85.
Rejection Code: ABSTRACT.

155. PORTER IJ, BRETT RW, and WISEMAN BM (1999). Alternatives to methyl bromide: Chemical fumigants or integrated pest management systems? *AUSTRALASIAN PLANT PATHOLOGY; 28* 65-71.
Rejection Code: NO TOX DATA.

156. PORTER IJ, MERRIMAN PR, and KEANE PJ (1991). Soil solarization combined with low rates of soil fumigants controls clubroot of cauliflowers, caused by Plasmodiophora brassicae

Woron. *AUST J EXP AGRIC; 31* 843-851.
Rejection Code: NO TOXICANT.

157. Reynolds, L. B., Olthof, T. H. A., and Potter, J. W. (1992). Effect of Fumigant Nematicides on Yield and Quality of Paste Tomatoes Grown in Southwestern Ontario. *J.Nematol.* 24: 656-661 .

158. RIEGEL, C., DICKSON DW, OU L-T, and PETERSON LG (1998). MANAGEMENT OF ROOT-KNOT NEMATODES IN SOIL ENHANCED FOR DEGRADING 1 3-DICHLOROPROPENE . *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, LAS VEGAS, NEVADA, USA, NOVEMBER 8-12, 1998. PHYTOPATHOLOGY; 88* S76.
Rejection Code: ABSTRACT.

159. Rieger, M., Krewer, G., and Lewis, P. (2001). Solarization and Chemical Alternatives to Methyl Bromide for Preplant Soil Treatment of Strawberries. *Horttechnology* 11: 258-264.

160. RODRIGUEZ-KABANA, R. and KOKALIS-BURELLE, N. (1997). CHEMICAL AND BIOLOGICAL CONTROL. *HILLOCKS, R. J. AND J. M. WALLER (ED.). SOILBORNE DISEASES OF TROPICAL CROPS. X+452P. CAB INTERNATIONAL: WALLINGFORD, ENGLAND, UK; NEW YORK, NEW YORK, USA. ISBN 0-85199-121-1.; 0 (0). 1997. 397-418.*
Rejection Code: REVIEW.

161. Ruzo, L. O. (2006). Physical, Chemical and Environmental Properties of Selected Chemical Alternatives for the Pre-Plant Use of Methyl Bromide as Soil Fumigant. *Pest Management Science, 62 (2) pp. 99-113, 2006.*
Rejection Code: NO TOX DATA.

162. Santos, B. M., Gilreath, J. P., and Motis, T. N. (2005). Managing Nutsedge and Stunt Nematode in Pepper With Reduced Methyl Bromide Plus Chloropicrin Rates Under Virtually Impermeable Films. *HortTechnology, 15 (3) pp. 596-599, 2005*.
Rejection Code: METHODS.

163. Santos, B. M., Gilreath, J. P., Motis, T. N., Von Hulten, M., and Siham, M. N. (2006). Effects of Mulch Types and Concentrations of 1,3-Dichloropropene Plus Chloropicrin on Fumigant Retention and Nutsedge Control. *HortTechnology, 16 (4) pp. 637-640, 2006*.
Rejection Code: METHODS.

164. Schneider, M., Quistad, G. B., and Casida, J. E. (Glutathione activation of chloropicrin in the Salmonella mutagenicity test. *Mutation Research-Genetic Toxicology and Environmental Mutagenesis. Vol. 439, no. 2, pp. 233-238. 19 Feb 1999.*
Rejection Code: HUMAN HEALTH.

165. Selala, M. I., Janssens, J. J., Jorens, P. G., Bossaert, L. L., Beaucourt, L., and Schepens, P. J. C. (1989). An improperly labeled container with chloropicrin: A farmer's nightmare. *Bulletin of Environmental Contamination and Toxicology [BULL. ENVIRON. CONTAM. TOXICOL.]* 42: 202-208.
Rejection Code: INHALE.

166. Sewell, G. W. F., Preece, D. A., and Elsey, R. F. (1988). Apple Replant Disease: The Influence of Soil Phosphorus and Other Factors on the Growth Responses of Apple Seedlings to Soil Fumigation with Chloropicrin. *Ann.Appl.Biol.* 113: 605-615.

167. Shaw, D. V. , Gordon, T. R., and Larson, K. D. (Runner plant cold storage reduces Verticillium dahliae infection of nursery origin in strawberry. *HortScience, 37 (6) pp. 932-935, 2002.*
Rejection Code: MIXTURE.

168. Shaw, D. V. and Larson, K. D. (A meta-analysis of strawberry yield response to preplant soil fumigation with combinations of methyl bromide-chloropicrin and four alternative systems. *HortScience, 34 (5) pp. 839-845, 1999.*
Rejection Code: MIXTURE.

169. SHAW DV and LARSON KD (1999). A meta-analysis of strawberry yield response to preplant soil fumigation with combinations of methyl bromide-chloropicrin and four alternative systems. *HORTSCIENCE; 34* 839-845.
Rejection Code: MIXTURE.

170. SHEPHERD JA and BARKER KR (1990). NEMATODE PARASITES OF TOBACCO. *LUC, M., R. A. SIKORA AND J. BRIDGE (ED.). PLANT PARASITIC NEMATODES IN SUBTROPICAL AND TROPICAL AGRICULTURE. XVII+629P. CAB INTERNATIONAL: WALLINGFORD, ENGLAND, UK. ILLUS. ISBN 0-85198-630-7.; 0 (0). 1990. 493-518.*
Rejection Code : NO TOX DATA.

171. SHETTY KG, SUBBARO KV, and MARTIN FN (1999). Management of Verticillium wilt in strawberry using vegetable crop rotation. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, MONTREAL, QUEBEC, CANADA, AUGUST 7-11, 1999.YPHYTOPATHOLOGY; 89* S72.
Rejection Code: NO TOX DATA.

172. Sparks, S. E., Quistad, G. B., and Casida, J. E. (1997). Chloropicrin: Reactions with Biological Thiols and Metabolism in Mice. *Chem.Res.Toxicol.* 10 : 1001-1007.

173. Sparks, S E, Quistad, G B, Li, W, and Casida, J E (2000). Chloropicrin dechlorination in relation to toxic action . *Journal Of Biochemical And Molecular Toxicology* 14: 26-32.
Rejection Code: METABOLISM.

174. SPARKS SE, QUISTAD GB, and CASIDA JE (1997). CHLOROPICRIN REACTIONS WITH BIOLOGICAL THIOLS AND METABOLISM IN MICE. *213TH NATIONAL MEETING OF THE AMERICAN CHEMICAL SOCIETY, SAN FRANCISCO, CALIFORNIA, USA, APRIL 13-17, 1997. ABSTRACTS OF PAPERS AMERICAN CHEMICAL SOCIETY* 213: AGRO 32.
Rejection Code: ABSTRACT.

175. SPETH TF and MILTNER RJ (1998). Technical note: Adsorption capacity of GAC for synthetic organics. *AMERICAN WATER WORKS ASSOCIATION JOURNAL; 90* 171-174.
Rejection Code: CHEM METHODS.

176. Spokas, K. and Wang, D. (2003). Stimulation of nitrous oxide production resulted from soil fumigation with chloropicrin. *Atmospheric Environment* 37: 3501-3507.
Rejection Code: BACTERIA.

177. Spokas, K., Wang, D., Venterea, R., and Sadowsky, M. (2006). Mechanisms of N2o Production Following Chloropicrin Fumigation. *Applied Soil Ecology* 31: 101-109.

Rejection Code: FATE.

178. Spokas, Kurt, Wang, Dong, and Venterea, Rodney (2005). Greenhouse gas production and emission from a forest nursery soil following fumigation with chloropicrin and methyl isothiocyanate. *Soil Biology and Biochemistry* 37: 475-485.
Rejection Code: NO TOX DATA.

179. Stansly, P. A., Conner, J. M., and Pomerinke, M. A. (1999). Impact of Biorational Insecticides on Southern Armyworm and Beet Armyworm in Bell Pepper, 1997. *Arthropod Manag.Tests* 24: 149-150 (E62).

180. STANSLY PA and CONNER JM (1996). CONTROL OF SOUTHERN ARMYWORM WITH BACILLUS THURINGIENSIS IN STAKED TOMATO FALL 1994. *BURDITT, A. K. JR. (ED.). ARTHROPOD MANAGEMENT TESTS, VOL. 21. IV+462P. ENTOMOLOGICAL SOCIETY OF AMERICA: LANHAM, MARYLAND, USA. ISBN 0-938522-55-8.; 21 (0). 1996. 191.*
Rejection Code: ABSTRACT.

181. STAPLETON JJ (1997). Verticillium wilt of almond in California. *JOINT CONFERENCE OF THE EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANISATION AND THE MEDITERRANEAN PHYTOPATHOLOGICAL UNION ON ALMOND PROTECTION, VALENCIA, SPAIN, NOVEMBER 19-21, 1996.YBULLETIN OEPP; 27* 489-492.
Rejection Code: REVIEW.

182. Stevens, T. S. (1997). The Use of Chemical Fumigants and Potential Alternatives at Weyerhaeuser Mima Nursery. *U.S.For.Serv.Gen.Tech.Rep.PNW* 389: 144-149.

183. STIMMANN MW and FERGUSON MP (1990). PROGRESS REPORT VICE PRESIDENT'S TASK FORCE ON PEST CONTROL ALTERNATIVES POTENTIAL PESTICIDE USE CANCELLATIONS IN CALIFORNIA USA. *CALIF AGRIC; 44* 12-16.
Rejection Code: NO TOX DATA.

184. Subbarao, K. V., Hubbard, J. C., and Koike, S. T. (Evaluation of broccoli residue incorporation into field soil for Verticillium wilt control in cauliflower. *Plant Disease, 83 (2) pp. 124-129, 1999.*
Rejection Code: METHODS.

185. Sullivan, D. A., Holdsworth, M. T., and Hlinka, D. J. (2004). Control of off-gassing rates of methyl isothiocyanate from the application of metam-sodium by chemigation and shank injection. *Atmospheric Environment* 38: 2457-2470.
Rejection Code: FATE.

186. SUMNER DR, GAY JD, GITAITIS RD, SMITTLE DA, MAW BW, and TOLLNER EW (1996). SOIL FUMIGATION AND SOILBORNE PATHOGENIC FUNGI IN SEEDBEDS OF SWEET ONION. *MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, SOUTHERN DIVISION, GREENSBORO, NORTH CAROLINA, USA, FEBRUARY 3-7, 1996. PHYTOPATHOLOGY; 86* S108.
Rejection Code: REVIEW.

187. Sydorovych, O., Safley, C. D., Ferguson, L. M., Poling, E. B., Fernandez, G. E., Brannen, P. M., Monks, D. M., and Louws, F. J. (2006). Economic Evaluation of Methyl Bromide

Alternatives for the Production of Strawberries in the Southeastern United States. *HortTechnology, 16 (1) pp. 118-128, 2006*.
Rejection Code: NO TOX DATA.

188. Tang, Man-Lai and Hirji, Karim F (2002). Simple polynomial multiplication algorithms for exact conditional tests of linearity in a logistic model. *Computer Methods And Programs In Biomedicine* 69: 13-23.
Rejection Code: MODELING.

189. TAYLOR GS (1987). NEMATICIDE ALTERNATIVES FOR CONNECTICUT USA CIGAR TOBACCO. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY (NORTHEASTERN DIVISION), NOVEMBER 5-7, 1986. PHYTOPATHOLOGY; 77 (1). 1987. 122.*
Rejection Code: ABSTRACT.

190. THIES JA and FERY RL (1997). USE OF RESISTANT PEPPERS TO MANAGE SOUTHERN ROOT-KNOT NEMATODES COMPARISON OF HOST PLANT RESISTANCE AND METHYL BROMIDE SOIL FUMIGATION. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, ROCHESTER, NEW YORK, USA, AUGUST 9-13, 1997. PHYTOPATHOLOGY; 87* S96.
Rejection Code: ABSTRACT.

191. Thies, W. G. and Nelson, E. E. (1987). Survival of Douglas-Fir Injected with the Fumigants Chloropicrin Methylisothiocyanate or Vorlex. *Northwest.Sci.* 61: 60-64.

192. THORNTON RE , STEVENS RG, and HAMMOND MW (1993). SELECTING THE SITE AND PREPARING IT FOR PLANTING. *ROWE, R. C. (ED.). POTATO HEALTH MANAGEMENT. X+178P. AMERICAN PHYTOPATHOLOGICAL SOCIETY (APS) PRESS: ST. PAUL, MINNESOTA, USA. ISBN 0-89054-144-2.; 0 (0). 1993. 11-18.*
Rejection Code: NO TOX DATA.

193. Tu, C. M., Marks, C. F., Johnson, P. W., and Elliot, J. M. (1995). Effects of Nematicides on Populations of Soil Microflora and Pratylenchus penetrans, Soil Enzymes and Flue-Cured Tobacco. *J.Environ.Sci.Health Part B* 30: 95-111.

194. Unruh, J. B., Brecke, B. J., Dusky, J. A., and Godbehere, J. S. (2002). Fumigant Alternatives for Methyl Bromide Prior to Turfgrass Establishment. *Weed Technol.* 16: 379-387.

195. VENKATESWARLU, K. (1993). PESTICIDE INTERACTIONS WITH CYANOBACTERIA IN SOIL AND PURE CULTURE. *BOLLAG, J.-M. AND G. STOTZKY (ED.). SOIL BIOCHEMISTRY, VOL. 8. XI+418P. MARCEL DEKKER, INC.: NEW YORK, NEW YORK, USA; BASEL, SWITZERLAND. ISBN 0-8247-9044-8.; 0 (0). 1993. 137-179.*
Rejection Code: REVIEW.

196. Wade, Elisabeth A., Reak, Kristina E., Parsons, Bradley F., Clemes, Thomas P., and Singmaster, Karen A. (2002). Photochemistry of chloropicrin in cryogenic matrices. *Chemical Physics Letters* 365: 473-479.
Rejection Code: CHEM METHODS.

197. WALLACE LL and SVEJCAR, T. (1987). MYCORRHIZAL AND CLIPPING EFFECTS ON ANDROPOGON-GERARDII PHOTOSYNTHESIS. *AM J BOT; 74* 1138-1142.

Rejection Code: NO TOXICANT.

198. Wang, D., Fraedrich, S. W., Juzwik, J., Spokas, K., Zhang, Y., and Koskinen, W. C. (2006). Fumigant Distribution in Forest Nursery Soils Under Water Seal and Plastic Film After Application of Dazomet, Metam-Sodium and Chloropicrin. *Pest Management Science, 62 (3) pp. 263-273, 2006*.
Rejection Code: FATE.

199. Wang, D., Juzwik, J., Fraedrich, S. W., Spokas, K., Zhang, Y., and Koskinen, W. C. (2005). Atmospheric Emissions of Methyl Isothiocyanate and Chloropicrin Following Soil Fumigation and Surface Containment Treatment in Bare-Root Forest Nurseries. *Canadian Journal of Forest Research, 35 (5) pp. 1202-1212, 2005*.
Rejection Code: NO TOX DATA.

200. Wang, Q., Gan, J., Papiernik, S. K., and Yates, S. R. (Transformation and detoxification of halogenated fumigants by ammonium thiosulfate. *Environmental Science and Technology, 34 (17) pp. 3717-3721, 2000*.
Rejection Code: BACTERIA.

201. Webster, T. M., Csinos, A. S., Johnson, A. W., Dowler, C. C., Sumner, D. R., and Fery, R. L. (2001). Methyl Bromide Alternatives in a Bell Pepper-Squash Rotation. *Crop Prot.* 20: 605-614 .

202. Weingartner, D. P. and Shumaker, J. R. (1990). Effects of Soil Fumigants and Aldicarb on Nematodes, Tuber Quality, and Yield in Potato. *J.Nematol.* 22: 767-774.

203. WELKE, B., ETTLINGER, K., and RIEDERER, M. (1998). Sorption of volatile organic chemicals in plant surfaces. *ENVIRONMENTAL SCIENCE & TECHNOLOGY; 32* 1099-1104.
Rejection Code: FATE.

204. Whitehead, A. G., Fraser, J. E., and French, E. M. (1979). Control of Potato Cyst-Nematode, Globodera pallida, on Tomatoes Grown Under Glass, by Applying Steam or Chemical Nematicides to the Soil. *Ann.Appl.Biol.* 92: 275-278.

205. WHITEHEAD AG (1986). TECHNIQUES OF APPLYING NEMATICIDES TO SOIL. *VIITH CIRCUM-MEDITERRANEAN PLANT PROTECTION MEETING, KHANIA, GREECE, SEPT. 24-28, 1984. BULL OEPP (ORGAN EUR MEDITERR PROT PLANT); 16 (2). 1986. 335-342*.
Rejection Code: NO TOX DATA.

206. WILHELM SN and SHEPLER, K. (1995). ENVIRONMENTAL FATE OF CHLOROPICRIN. *210TH AMERICAN CHEMICAL SOCIETY NATIONAL MEETING, CHICAGO, ILLINOIS, USA, AUGUST 20-24, 1995. ABSTRACTS OF PAPERS AMERICAN CHEMICAL SOCIETY; 210* AGRO 76.
Rejection Code: ABSTRACT,FATE.

207. Williams, D. T., LeBel, G. L., and Benoit, F. M. (1997). Disinfection by-products in Canadian drinking water. *Chemosphere* 34: 299-316.
Rejection Code: NO TOX DATA.

208. WILLIAMS DT , LEBEL GL, and BENOIT FM (1997). Disinfection by-products in Canadian

drinking water. *CHEMOSPHERE; 34* 299-316.
Rejection Code: EFFLUENT.

209. WORTHING CR (1991). THE PESTICIDE MANUAL A WORLD COMPENDIUM 9TH EDITION. *WORTHING, C. R. (ED.). THE PESTICIDE MANUAL: A WORLD COMPENDIUM, 9TH EDITION. XLVII+1141P. BRITISH CROP PROTECTION COUNCIL: FARNHAM, ENGLAND, UK. ILLUS. ISBN 0-948404-42-6.; 0 (0). 1991. XLVII+1141P.*
Rejection Code: NO TOX DATA.

210. WU WW, CHADIK PA, DAVIS WM, POWELL DH, and DELFINO JJ (1998). Disinfection byproduct formation from the preparation of instant tea. *JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY; 46* 3272-3279 .
Rejection Code: NO TOX DATA.

211. XIAO CL and DUNIWAY JM (1998). BACTERIAL POPULATION RESPONSES TO SOIL FUMIGATION AND THEIR EFFECTS ON STRAWBERRY GROWTH. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, LAS VEGAS, NEVADA, USA, NOVEMBER 8-12, 1998. PHYTOPATHOLOGY; 88* S100.
Rejection Code: ABSTRACT.

212. YOSHIDA, M. , IKEDA, T., IWASAKI, M., TSUDA, S., and SHIRASU, Y. (1987). ACUTE INHALATION TOXICITY OF CHLOROPICRIN VAPOR IN RATS. *J PESTIC SCI; 12* 237-244.
Rejection Code: INHALE.

213. YOSHIDA, M. , MURAO, N., TSUDA, S., and SHIRASU, Y. (1991). Effects of mode of exposure on acute inhalation toxicity of chloropicrin vapor in rats. *J PESTIC SCI; 16* 63-70.
Rejection Code: INHALE.

214. YUEN GY, SCHROTH MN, HANCOCK JG, and WEINHOLD AR (1988). DIFFERENTIAL EFFECTS OF VARIOUS PREPLANT SOIL TREATMENTS ON THE ROOT FUNGAL MICROFLORA ROOT GROWTH AND YIELD OF STRAWBERRY. *ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY AND THE PACIFIC DIVISION, SAN DIEGO, CALIFORNIA, USA, NOVEMBER 13-17, 1988. PHYTOPATHOLOGY; 78* 1545.
Rejection Code: ABSTRACT.

215. Zentmyer, G. A. and Klotz, L. J. (1947). Two Causes of Avocado Decline. *Citrus Leaves* 27: 18,20,22.
Rejection Code: NO CONC.

216. Zhang, Guangming and Hua, Inez (2000). Ultrasonic degradation of trichloroacetonitrile, chloropicrin and bromobenzene: design factors and matrix effects. *Advances in Environmental Research* 4: 219-224.
Rejection Code: CHEM METHODS.

217. Zheng, W., Papiernik, S. K., Guo, M., and Yates, S. R. (Competitive degradation between the fumigants chloropicrin and 1,3-dichloropropene in unamended and amended soils. *Journal of Environmental Quality, 32 (5) pp. 1735-1742, 2003.*
Rejection Code: FATE.

218. Zheng, Wei, Papiernik, Sharon K, Guo, Minxing, and Yates, Scott R (Competitive degradation between the fumigants chloropicrin and 1,3-dichloropropene in unamended and amended

soils. *Journal Of Environmental Quality* 32: 1735-1742.
Rejection Code: FATE.

219. Zheng, Wei, Yates, Scott R, Guo, Mingxin, Papiernik, Sharon K, and Kim, Jung Ho (2004). Transformation of chloropicrin and 1,3-dichloropropene by metam sodium in a combined application of fumigants. *Journal Of Agricultural And Food Chemistry* 52: 3002-3009.
Rejection Code: FATE.

220. Zheng, Wei, Yates, Scott R, Papiernik, Sharon K, and Guo, Mingxin (Effect of combined application of methyl isothiocyanate and chloropicrin on their transformation. *Journal Of Environmental Quality* 33: 2157-2164.
Rejection Code: FATE.

221. Zhou, X. G. and Everts, K. L. (Suppression of fusarium wilt of watermelon by soil amendment with hairy vetch. *Plant Disease, 88 (12) pp. 1357-1365, 2004.*
Rejection Code: NO TOX DATA.

Appendix E: Product Formulations Containing Multiple Active Ingredients

The Agency does not routinely include, in its risk assessments, an evaluation of mixtures of active ingredients, either those mixtures of multiple active ingredients in product formulations or those in the applicator's tank. In the case of the product formulations of active ingredients (that is, a registered product containing more than one active ingredient), each active ingredient is subject to an individual risk assessment for regulatory decision regarding the active ingredient on a particular use site. If effects data are available for a formulated product containing more than one active ingredient, they may be used qualitatively or quantitatively[1] [2].

There are no product LD50 values, with associated 95% Confidence Intervals (CIs) available for chloropicrin, based on the HED examination of registrant submitted data shown below.

As discussed in USEPA (2000) a quantitative component-based evaluation of mixture toxicity requires data of appropriate quality for each component of a mixture. In this mixture evaluation an LD50 with associated 95% CI is needed for the formulated product. The same quality of data is also required for each component of the mixture. Given that the formulated products for chloropicrin do not have LD50 data available it is not possible to undertake a quantitative or qualitative analysis for potential interactive effects. However, because the active ingredients are not expected to have similar mechanisms of action, metabolites, or toxicokinetic behavior, it is reasonable to conclude that an assumption of dose-addition would be inappropriate. Consequently, an assessment based on the toxicity of chloropicrin is the only reasonable approach that employs the available data to address the potential acute risks of the formulated products.

Also, for chloropicrin, the refined terrestrial wildlife assessment is based on inhalation of off-gassed pesticide, not dietary exposure. Since the other fumigants occurring in mixtures with chloropicrin could have substantially different Henry's Law Constants and volatility than chloropicrin, off-gassing is not expected to occur at the same rate as for chloropicrin. Thus (as with runoff and aquatic exposure), any inhalation exposure would not be to the same proportions of ingredients found in the original mixtures. Thus, it is appropriate to assess chloropicrin based on single active ingredient data.

[1] Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs, Environmental Protection Agency (January 2004) (Overview Document).

[2] Memorandum to Office of Prevention, Pesticides and Toxic Substance, US EPA conveying an evaluation by the U.S. Fish and Wildlife Service and National Marine Fisheries Service of an approach to assessing the ecological risks of pesticide products (January 2004).

Pesticide Products Formulated with Chloropicrin and Other Pesticide Active Ingredients

CHLOROPICRIN PRODUCTS [i]

PRODUCT/TRADE NAME	EPA Reg.No.	% Chloropicrin	PRODUCT LC 50 (mg/L)	PRODUCT CI (mg/kg)	ADJUSTED FOR ACTIVE INGREDIENT A.I Adjusted LD50 (mg/kg)	ADJUSTED FOR ACTIVE INGREDIENT A.I Adjusted (mg/kg)
50-50 preplant soil fumigant	8622-39	50	ND	ND	ND	ND
57-43 preplant soil fumigant	8622-40	43	ND	ND	ND	ND
67-33	5785-52	33	ND	ND	ND	ND
67-33 preplant soil fumigation	8622-13	33	ND	ND	ND	ND
75-25 preplant soil fumigant	8622-15	25	ND	ND	ND	ND
80-20 preplant soil fumigant	8622-44	20	ND	ND	ND	ND
Dowfume mc-33 fumigant	3377-17	33	ND	ND	ND	ND
Glc terr-o-gas 75 preplant soil fumigant	5785-40	25	ND	ND	ND	ND
Inline	62719-348	33.3	>0.1003 mg/L	ND	ND	ND
M-b-r 75	3377-30	25	ND	ND	ND	ND
Mbc-33 soil fumigant	8853-3	33	ND	ND	ND	ND
Pic brom 25	8536-11	25	ND	ND	ND	ND
Pic clor 60	8536-8	59.4	ND	ND	ND	ND
Pic-brom 33	8536-5	33	ND	ND	ND	ND
Pic-brom 43	8536-7	43	ND	ND	ND	ND
Pic-brom 50	8536-9 and CA770058	50	ND	ND	ND	ND
Pic-brom 55	8536-6	55	ND	ND	ND	ND
Pic-brom 67	8536-20	67	ND	ND	ND	ND
Pic-clor 15	8536-21	14.8	ND	ND	ND	ND

PRODUCT/TRADE NAME	EPA Reg.No.	% Chloropicrin	PRODUCT		ADJUSTED FOR ACTIVE INGREDIENT	
			LC 50 (mg/L)	CI (mg/kg)	A.I Adjusted LD50 (mg/kg)	A.I Adjusted (mg/kg)
Pic-clor 30	8536-22	29.7	ND	ND	ND	ND
Reddick Bro-Mean C-2R	37733-5	2	ND	ND	ND	ND
Reddick bro-mean c-33	37733-6	33	ND	ND	ND	ND
Telone c-15	11220-20	14.8	ND	ND	ND	ND
Telone c-17	62719-12	16.5	ND	ND	ND	ND
Telone c-35	62719-302	34.7	ND	ND	ND	ND
Terr-o-gas 33 preplant soil fumigant	5785-25	67	ND	ND	ND	ND
Terr-o-gas 45	5785-23	55	ND	ND	ND	ND
Terr-o-gas 50	5785-48	50	ND	ND	ND	ND
Terr-o-gas 57 preplant soil fumigant	5785-28	43	ND	ND	ND	ND
Terr-o-gas 67	5785-24	33	ND	ND	ND	ND
Terr-o-gas 70 preplant soil fumigant	5785-19	30	ND	ND	ND	ND
Terr-o-gas 80	5785-47	20	ND	ND	ND	ND
Terr-o-gas 98	5785-22	2	ND	ND	ND	ND
Tri-con 45/55	11220-11	54.5	ND	ND	ND	ND
Tri-con 50/50	11220-10	50	ND	ND	ND	ND
Tri-con 57/43 preplant soil fumigant	11220-4	42.6	ND	ND	ND	ND
Tri-con 67/33	11220-7	32.7	ND	ND	ND	ND
Tri-con 75/25	11220-8	24.8	ND	ND	ND	ND
Tri-con 80/20	58266-1	19.8	ND	ND	ND	ND
Tri-form 30	11220-21	29.7	ND	ND	ND	ND
Tri-form 35	11220-22	34.6	ND	ND	ND	ND

PRODUCT/TRADE NAME	EPA Reg.No.	% Chloropicrin	PRODUCT LC 50 (mg/L)	CI (mg/kg)	ADJUSTED FOR ACTIVE INGREDIENT A.I Adjusted LD50 (mg/kg)	A.I Adjusted (mg/kg)
Tri-form 40/60	11220-15	60	ND	ND	ND	ND

[1] From registrant submitted data to support registration. Compiled by Office of Pesticide Programs Health Effects Division.

Appendix F -Chloropicrin Maps

Use List

The following use list is derived from label use information. It is used as a basis for terrestrial and aquatic pesticide use area determination.

Table 1 Use list from labels

Category	Use
Agriculture & Greenhouse/Nursery	All crops (except orchard and pasture crops); ornamental/shade trees, ornamental herbaceous plants, ornamental non-flowering plants, and ornamental woody shrubs and vines
Orchards/vineyards	All orchard/vineyard crops
Pasture	All pasture-related crops
Forestry**	Forest trees
Non-agriculture (not mapped)	Airtight chambers, commercial storages/warehouse premises, commercial facilities (non-food/non-feed), compost/compost piles, food processing plant premises, golf course turf, ornamental lawns and turf, non-ag rights of way, fencerows, hedgerows, non-ag uncultivated areas/soils, recreational area lawns, recreational areas

*****Forestry use is not included in the initial area of concern nor the action area in the following maps and calculations, as this use could not be assessed quantitatively. Further discussion on forestry use is included in the main document.***

Terrestrial Use Determination

Sources and Methods

Base mapping layers for the terrestrial analysis component were obtained from the National Land-cover Dataset (NLCD 2001) for the majority of land use types and the California GAP data (6/98) for the orchards and vineyard uses. The NLCD is a recently released national land use dataset and the GAP is from the Biogeography Lab from UCLA-Santa Barbara. These raster files were converted to vector and used in the analysis. Table 2 shows the land-cover sources used.

Table 2 Land-cover data sources

Land-cover Data Sources			
Layer name	**Base source**	**Description**	**non-NASS**
Cultivated Crops	NLCD	82: Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.	No
Developed, High Intensity	NLCD	24: Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to100 percent of the total cover.	Yes
Developed, Low Intensity	NLCD	22: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These	Yes

Land-cover Data Sources			
Layer name	**Base source**	**Description**	**non-NASS**
		areas most commonly include single-family housing units.	
Developed, Medium Intensity	NLCD	23: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.	Yes
Developed, Open Space	NLCD	21: Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.	Yes
Forest	NLCD	Union of 41,42,43: Deciduous, evergreen and mixed. Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover.	Yes
Open Water	NLCD	11: All areas of open water, generally with less than 25% cover of vegetation or soil.	Yes
Orchards and vineyards	CA GAP	A union of 11210, 11211 and 11212. This is the only CA GAP reference.	No
Pasture/Hay	NLCD	81: Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.	No
Wetlands	NLCD	Union of 90, 95: Woody wetlands and emergent herbaceous.	Yes

U.S. Department of Agriculture's National Agriculture Statistics Service (NASS) census dataset, 2002 was used to determine whether a crop was grown in a particular county. This census dataset provides survey information over five years on agricultural practices and is used mainly for cultivated or agriculture crops. Chemical labeled uses were matched to NASS uses; an agriculture use match would result in a mapped area for one or more counties. For uses that are not agricultural, the use is assumed to occur in every county where that particular land-cover occurs within California (*i.e.* a 'forestry' labeled use is assumed to potentially occur in all California counties where NLCD indicates there is forest land-cover).

The 'Initial Area of Concern' represents the use type and its occurrence in the NASS or NLCD datasets. These are the areas where the pesticide has potential to be applied. The 'Action Area' represents the 'Initial Area of Concern' plus a buffer distance. There may not always be a buffer distance in which case the 'Action Area' is the same as the 'Initial Area of Concern'. The overlap of the 'Action Area' with CRLF habitat areas is named 'Overlapping Area' and is the target of spatial analysis. The ratio of Overlapping Area to CRLF habitat area is reported for each of eight Recovery Units (RU1 to RU8).

There are three types of CRLF habitat areas considered in this assessment: Critical Habitat (CH); Core Areas; and California Natural Diversity Database (CNDDB) occurrence sections (EPA

Region 9). Critical habitat areas were obtained from the U.S. Fish and Wildlife Service's (USFWS) final designation of critical habitat for the CRLF (USFWS 2006). Core areas were obtained from USFWS's Recovery Plan for the CRLF (USFWS 2002). The occurrence sections represent an EPA-derived subset of occurrences noted in the CNDDB. They are generalized by the Meridian Range and Township Section (MTRS) one square mile units so that individual habitat areas are obfuscated. As such, only occurrence section counts are provided and not the area potentially affected.

Table 3 Terrestrial spatial summary results for chloropicrin uses (agriculture, pasture, orchard/vineyard) with no buffer.

Measure	RU1	RU2	RU3	RU4	RU5	RU6	RU7	RU8	Total
Initial Area of Concern (no buffer)									43,378 sq km
Action Area – Initial area of concern + buffer									43,378 sq km
Established species range area (sq km)	3654	2742	1323	3279	3650	5306	4917	3326	28,197
Overlapping area (sq km)	8	85	18	35	144	355	422	256	1323
Percent area affected	*0.2*	*3.1*	*1.4*	*0.2*	*3.9*	*6.7*	*8.6*	*7.7*	*4.7*
# Occurrence Sections	2	0	9	73	145	46	59	8	342

Aquatic Action Area Delineation

The aquatic analysis uses a downstream dilution model to determine the downstream extent of exposure in streams and rivers. The downstream component, combined with the initial area of concern, define the aquatic action area. The downstream extent includes the area where the EEC could potentially be above levels that would exceed the most sensitive LOC. The model calculates two values, the dilution factor (DF) and the threshold Percent Cropped Area (PCA). The dilution factor (DF) is the maximum RQ/LOC, and the threshold PCA is the inverse value represented as a percent.

The dilution model uses the NHDPlus data set (http://www.horizon-systems.com/nhdplus/) as the framework for the downstream analysis. The NHDPlus includes several pieces of information that can be used to analyze downstream effects. For each stream reach in the hydrography network, the data provide a tally of the total area in each NLCD land cover class for the upstream cumulative area contributing to the given stream reach. Using the cumulative land cover data provided by the NHDPlus, an aggregated use class is created based on the classes listed in Table 2. A cumulative PCA is calculated for each stream reach based on the aggregate use class (divided by the total upstream contribution area).

The dilution model traverses downstream from each stream segment within the initial area of concern. At each downstream node, the threshold PCA is compared to the aggregate cumulative PCA. If the cumulative PCA exceeds the threshold then the stream segment is included in the downstream extent. The model continues traversing downstream until the cumulative PCA no longer exceeds the threshold. The additional stream length by the downstream analysis is presented in Table 4.

Table 4 Aquatic spatial quantitative results for agriculture areas.

Measure	Total
Total California stream kilometers	332,962
Total stream kilometers in initial area of concern	65,444
Total stream kilometers added downstream	6,652
Total stream kilometers in final action area	72,096

A Note on Limitations and Constraints of Tabular and Geospatial Sources

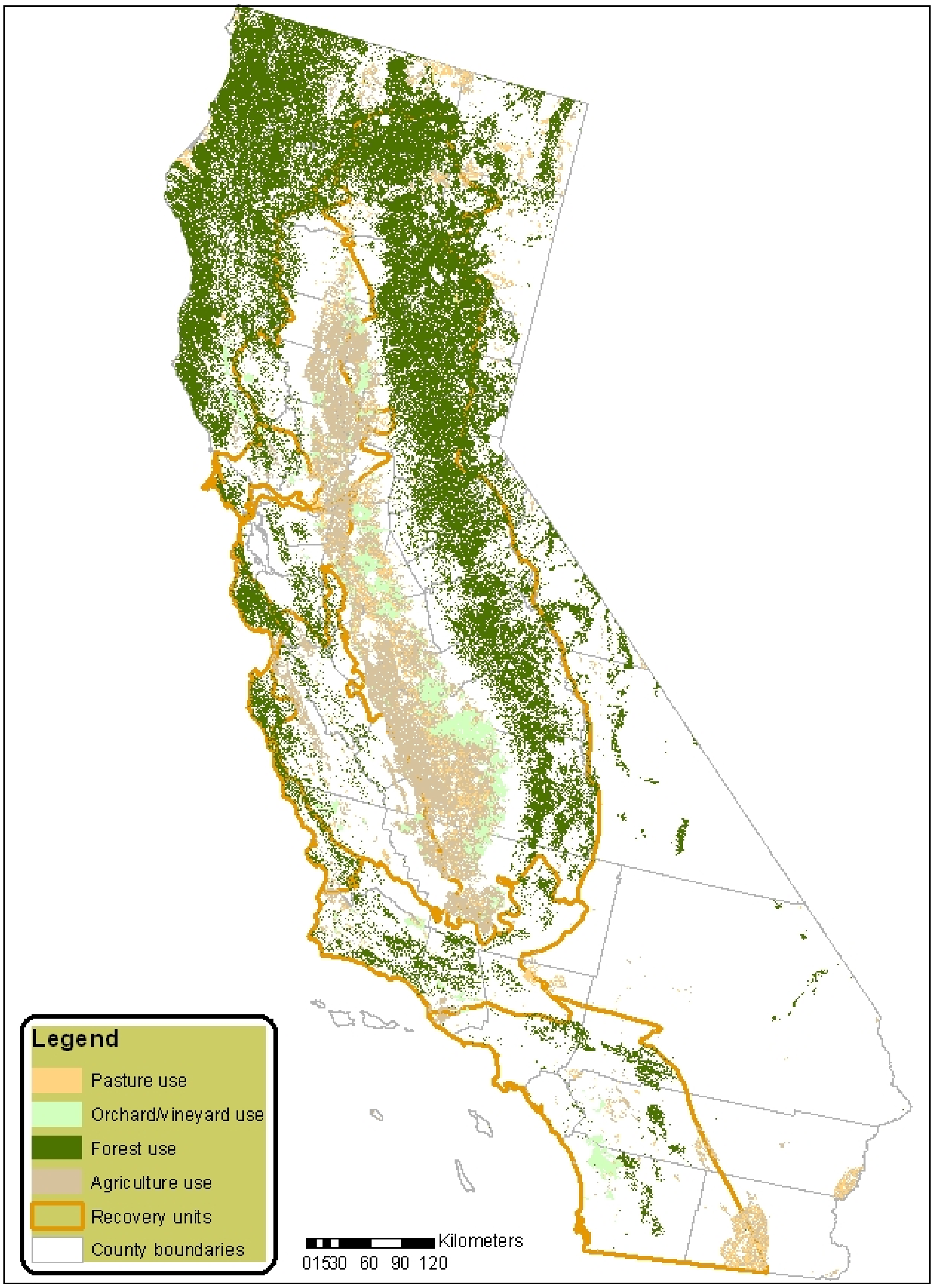
The geographic data sets used in this analysis are limited with respect to their accuracy and timeliness. The NASS Census of Agriculture (NASS 2002) contains adjusted survey data collected prior to 2002. Small use sites, and minor uses (e.g., specialty crops) tend to be underrepresented in this dataset. The National Land Cover Dataset (NLCD 2001) represents the best comprehensive collection of national land use and land cover information for the United

States representing a range of years from 1994 – 1998. Because the NLCD does not explicitly include a class to represent orchard and vineyard landcover, California Gap Analysis Project data (CaGAP 1998) were overlaid with the NCLD and used to identify these areas.

Hydrographic data are from the NHDPlus dataset (http://www.horizon-systems.com/nhdplus/). NHDPlus contains the most current and accurate nationwide representation of hydrologic data. In some isolated instances, there are, however, errors in the data including missing or disconnected stream segments and incorrect assignment of flow direction. Spatial data describing the recovery zones and core areas are from the US Fish and Wildlife Service. The data depicting survey sections in which the species has been found in past surveys is from the California Natural Diversity Database (http://www.dfg.ca.gov/bdb/html/cnddb.html).

The relatively coarse spatial scale of these datasets precludes use of the data for highly localized studies, therefore, tabular information presented here is limited to the scale of individual Recovery Units. Additionally, some labeled uses are not possible to map precisely due to the lack of appropriate spatial data in NLCD on the location of these areas. To account for these uncertainties, the spatial analysis presented here is conservative, and may overestimate the areal extent of actual pesticide use in California.

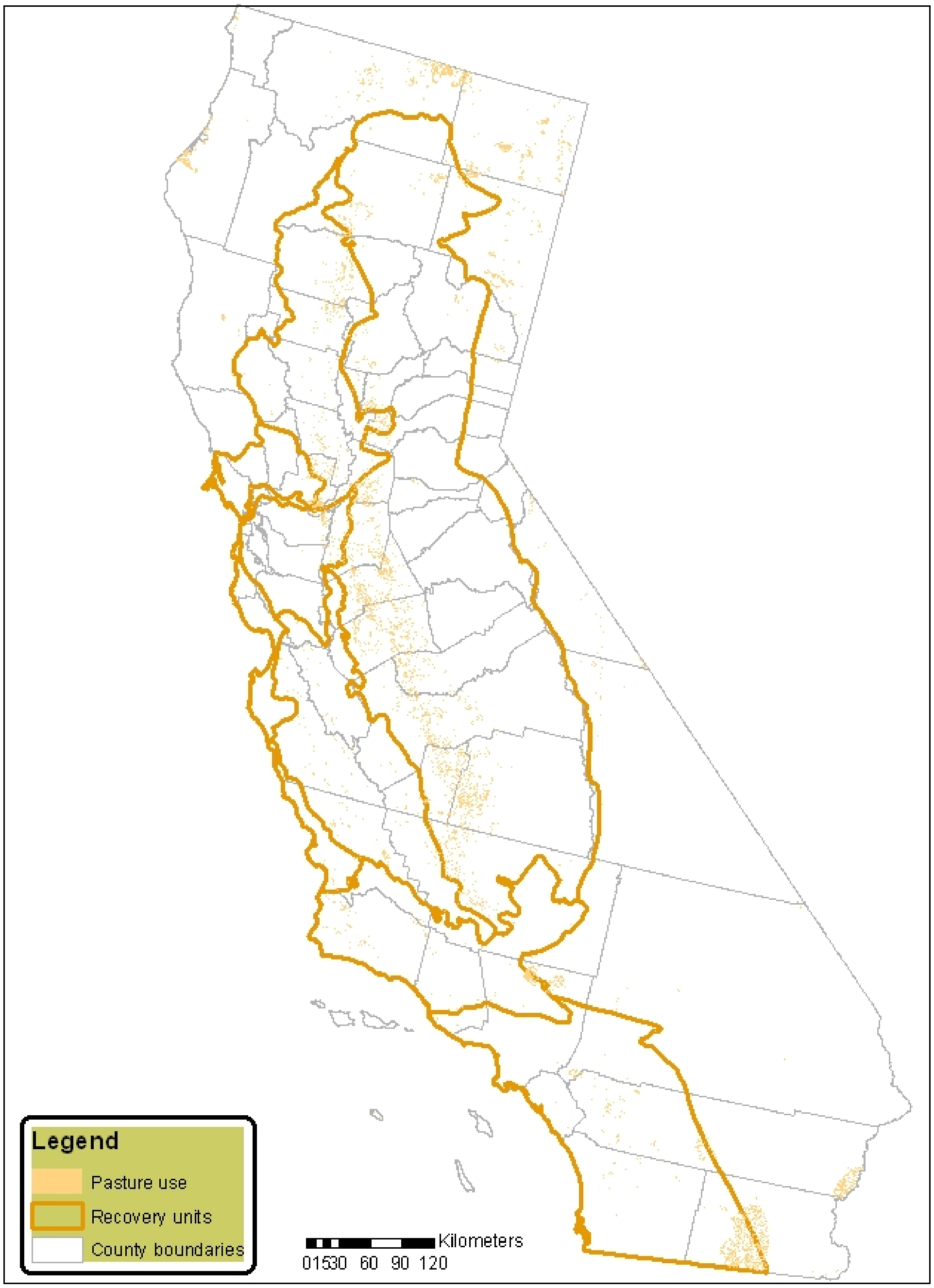
Chloropicrin Use



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

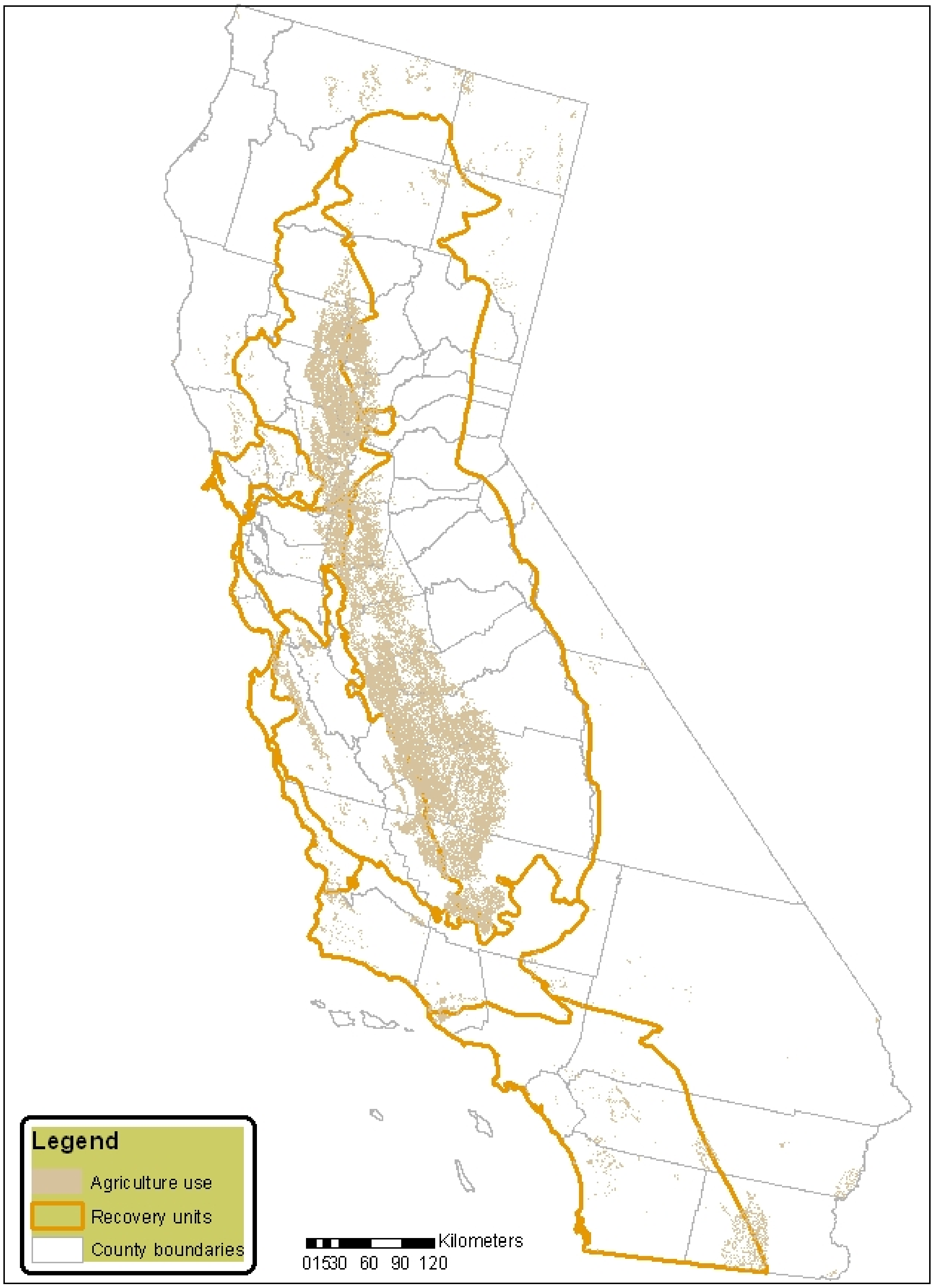
Chloropicrin - Pasture Use



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

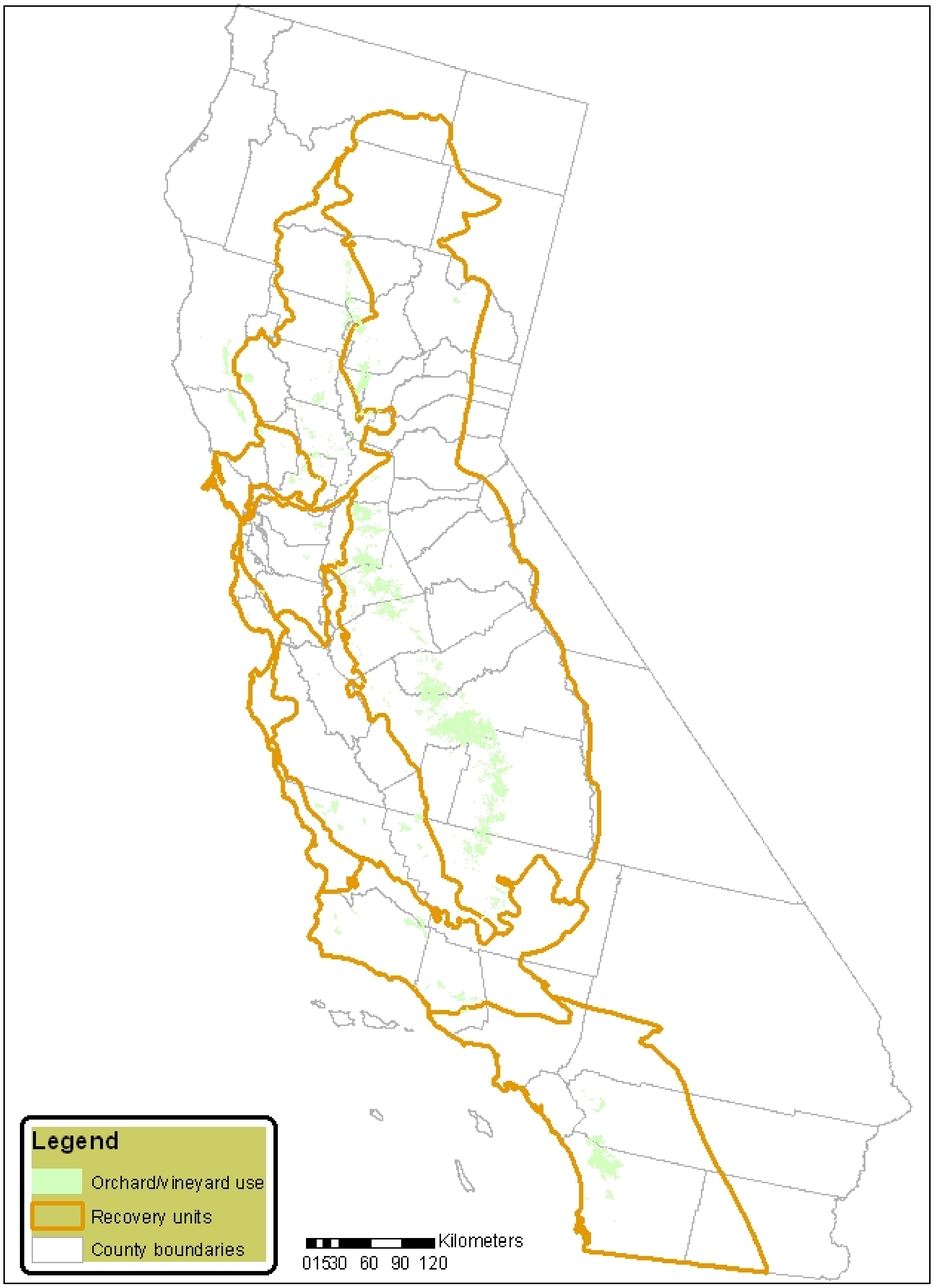
Chloropicrin - Agriculture Use



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

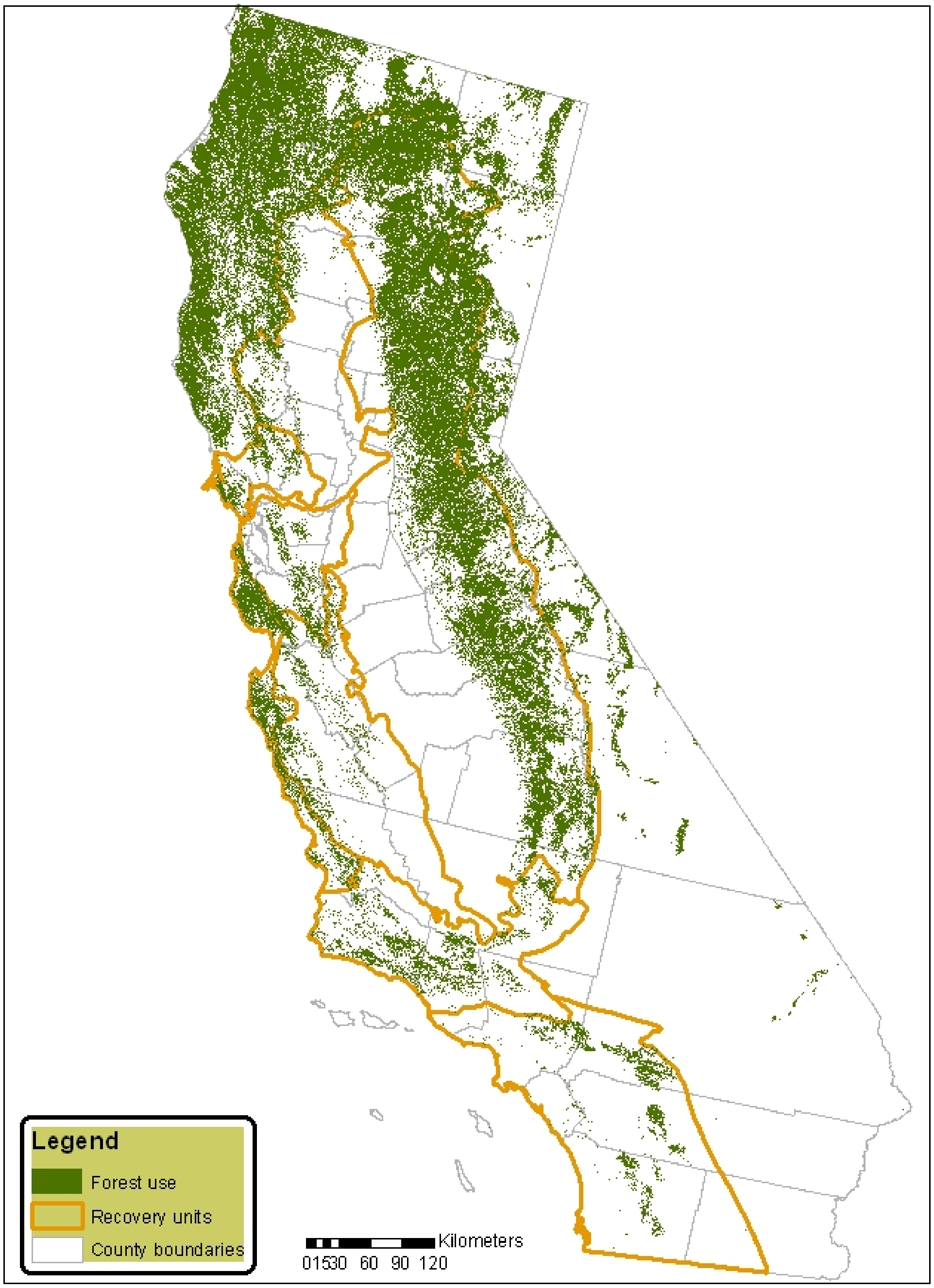
Chloropicrin - Orchard/Vineyard Use



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

Chloropicrin - Forestry Use



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

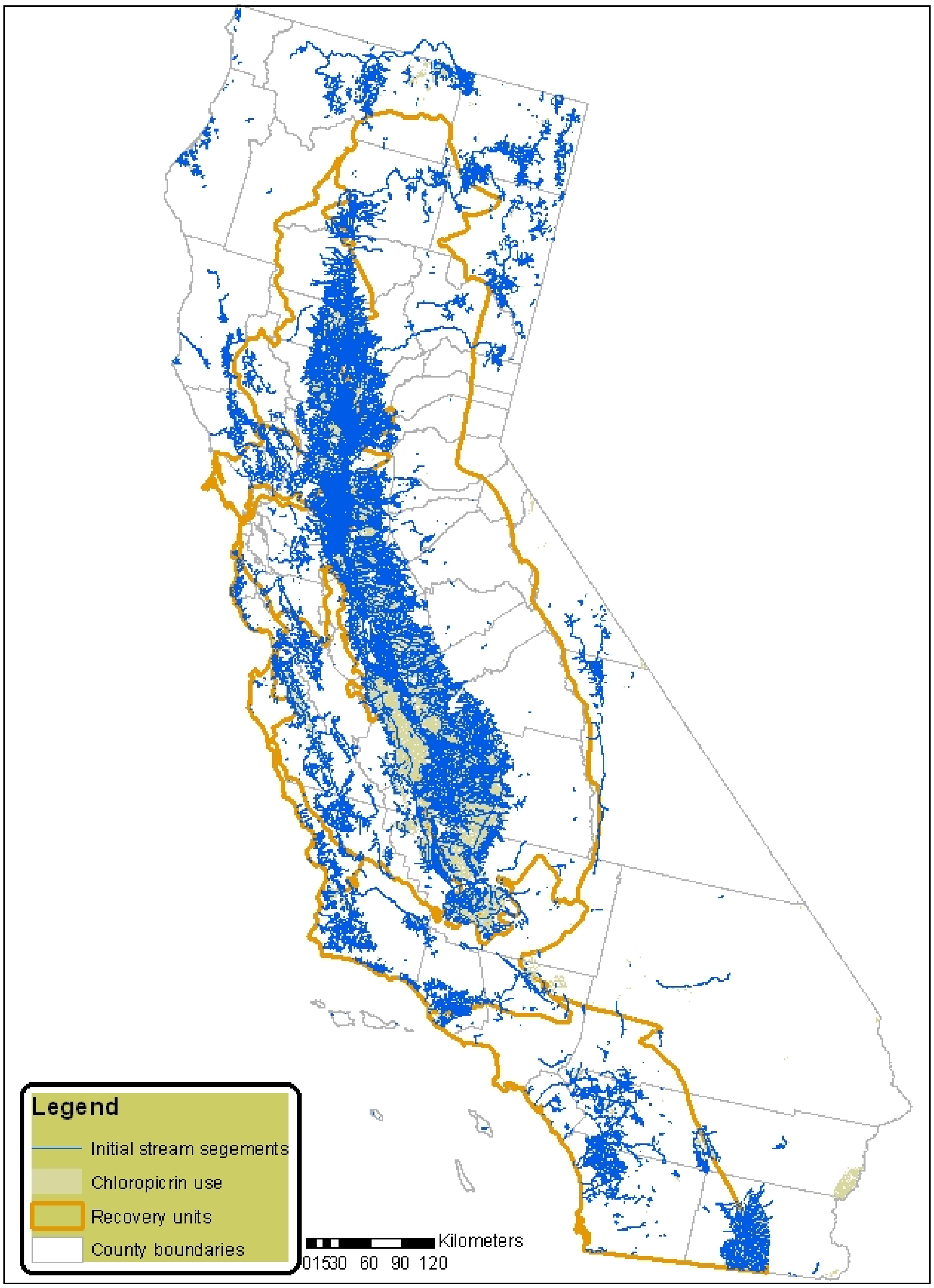
Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

CRLF Habitat Areas

Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. June 15, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

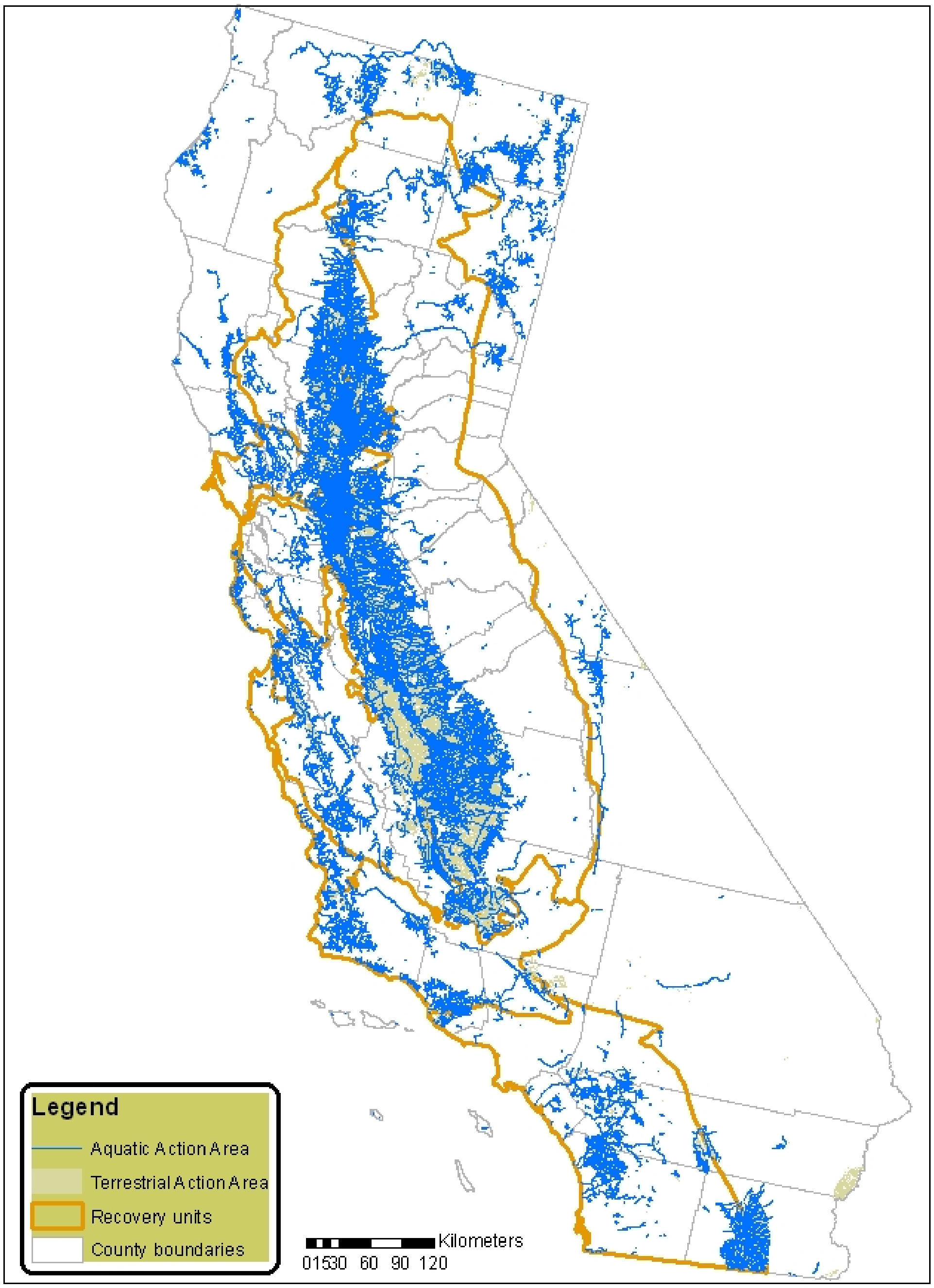
Chloropicrin - Initial Area of Concern



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

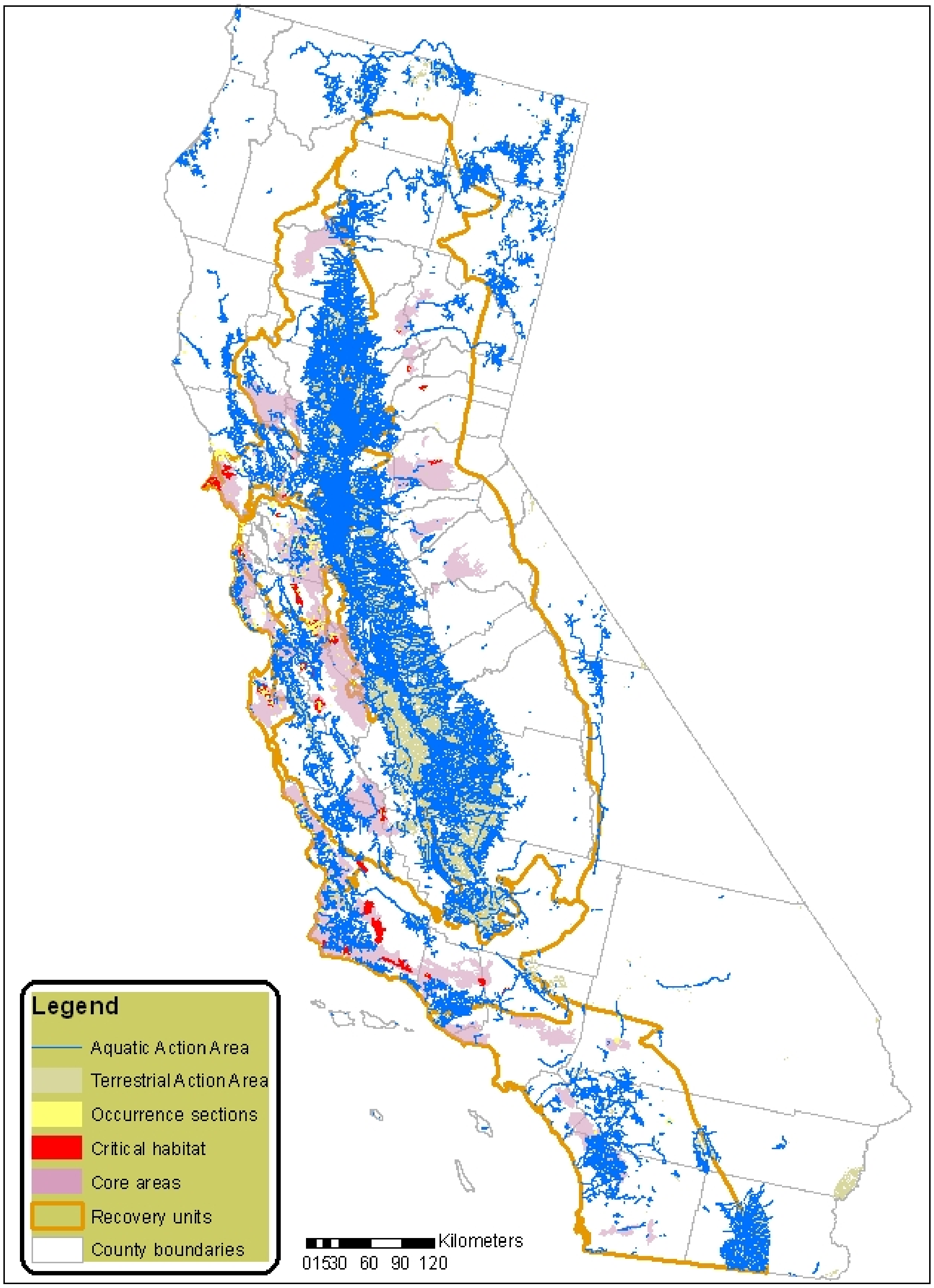
Chloropicrin - Action Area



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

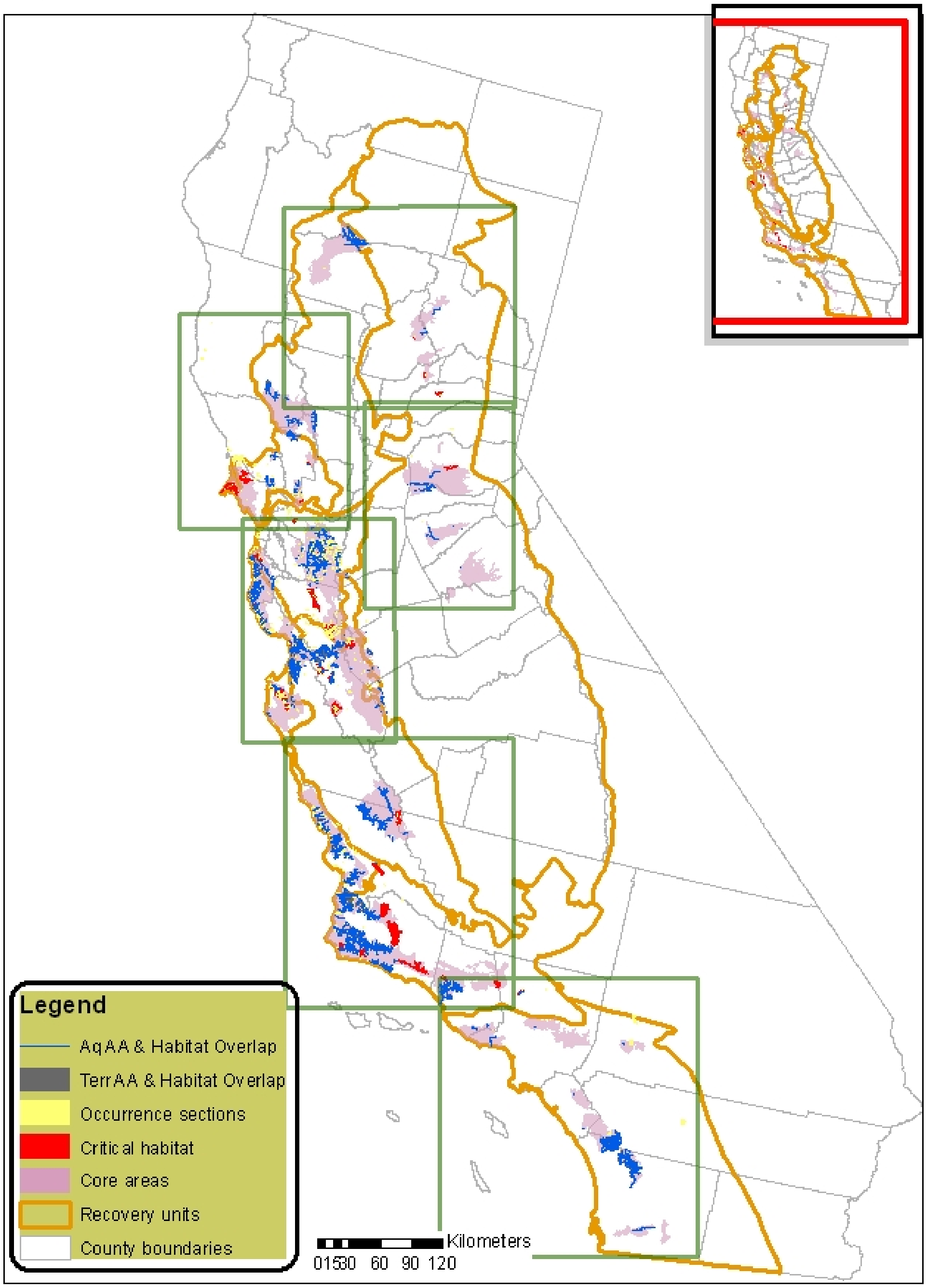
Chloropicrin - Action Area & CRLF Habitat



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

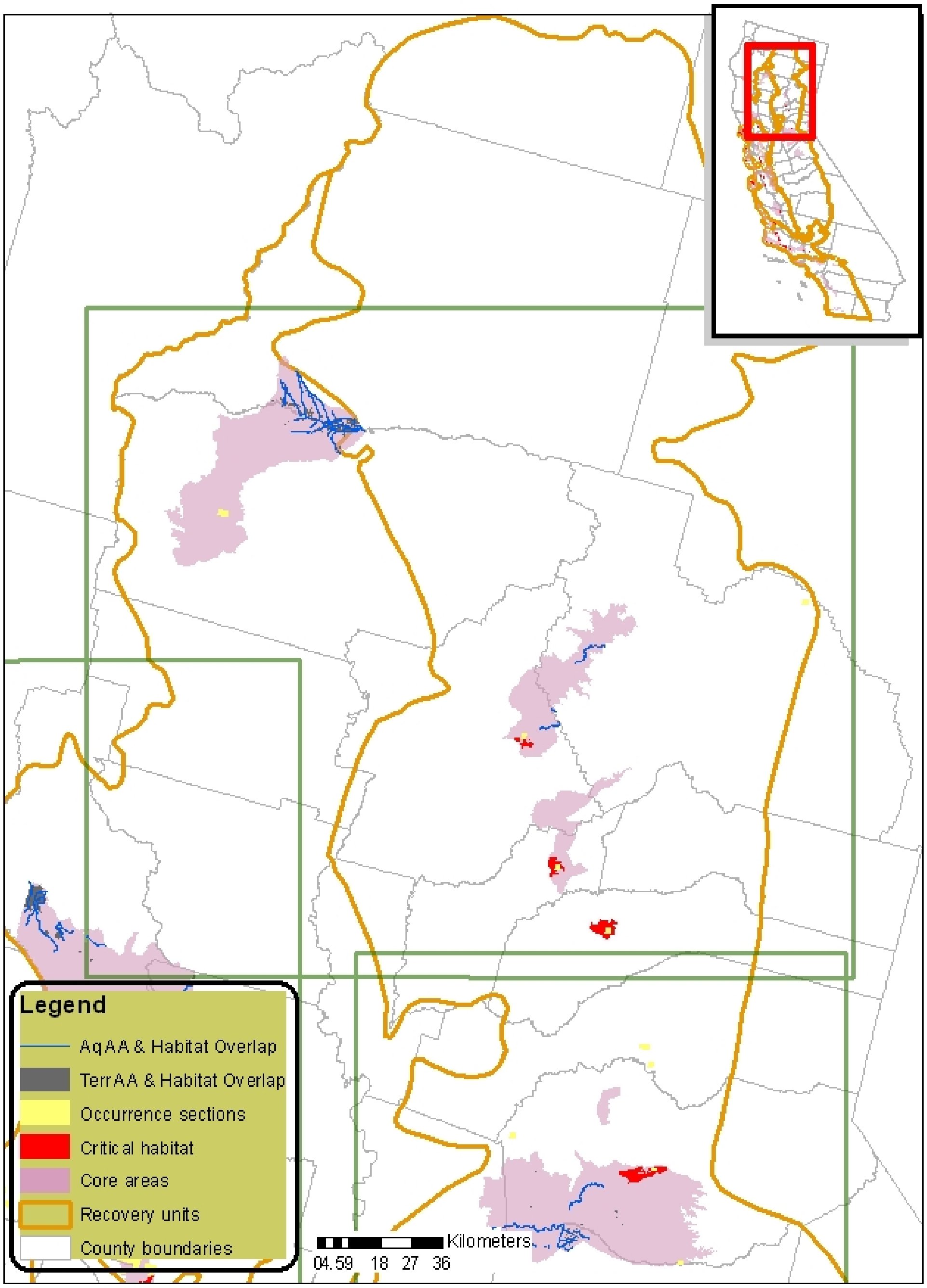
Chloropicrin - Action Area & Habitat Overlap (Statewide)



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

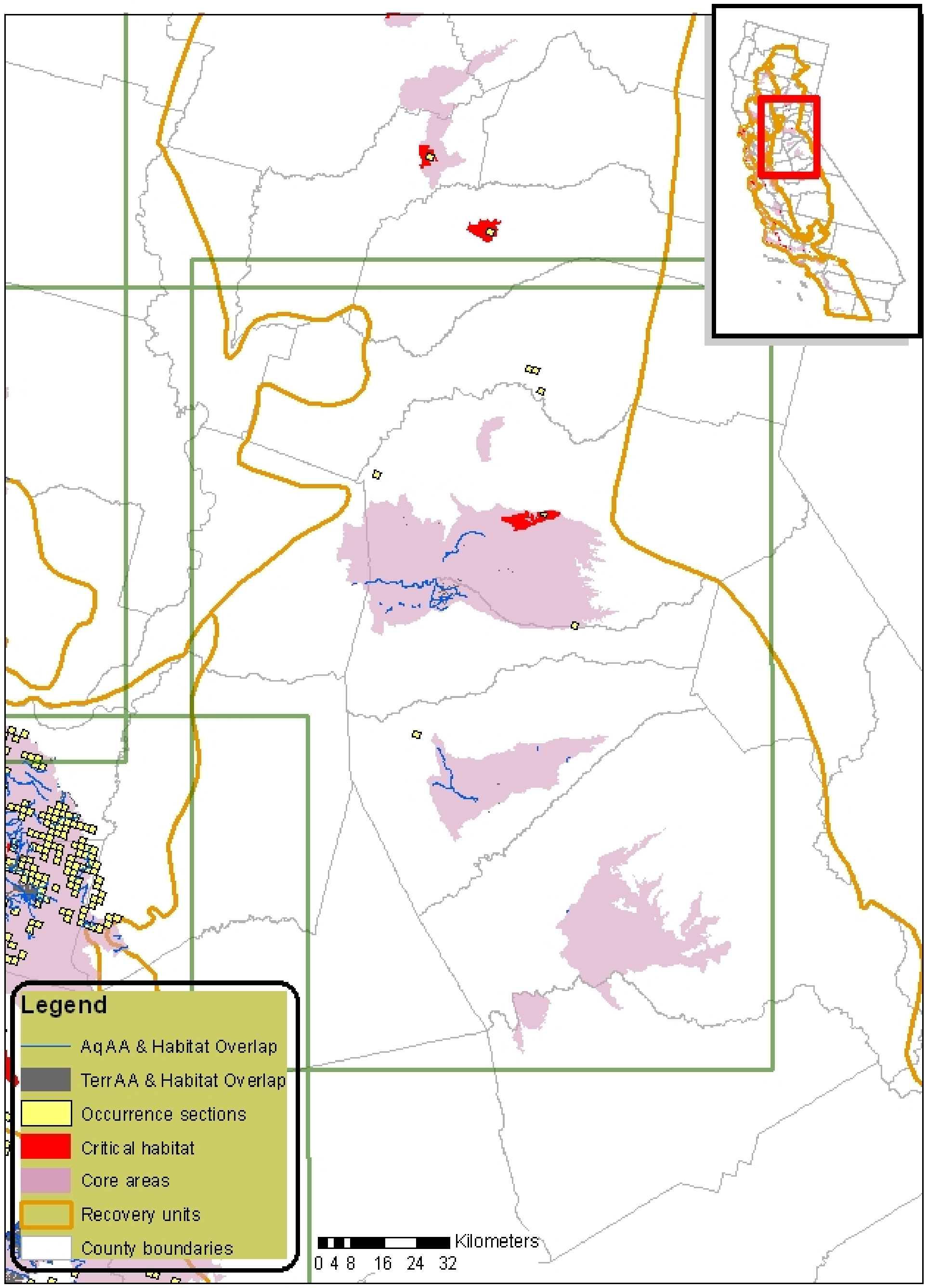
Chloropicrin - Action Area & Habitat Overlap 1



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

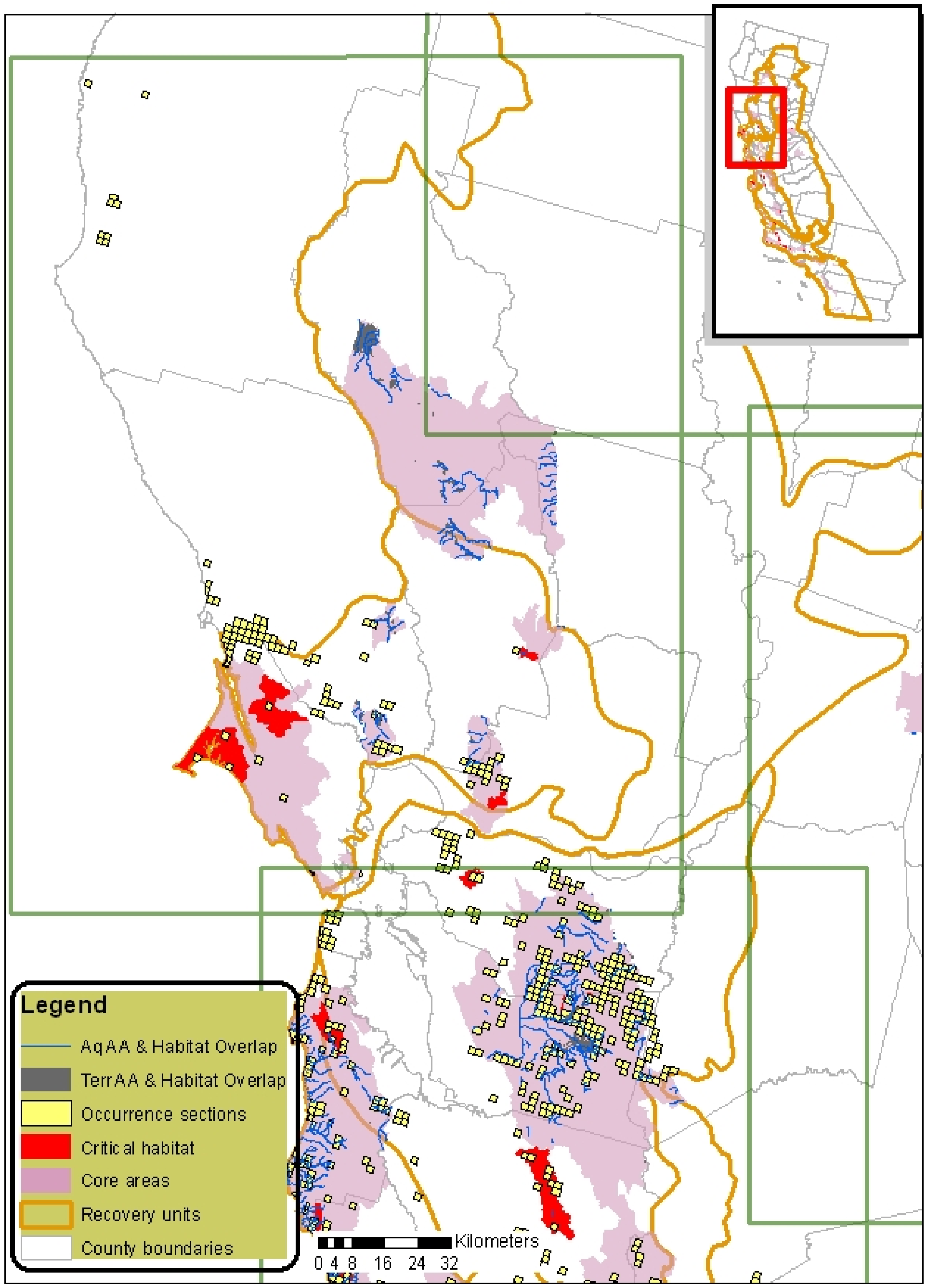
Chloropicrin - Action Area & Habitat Overlap 2



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

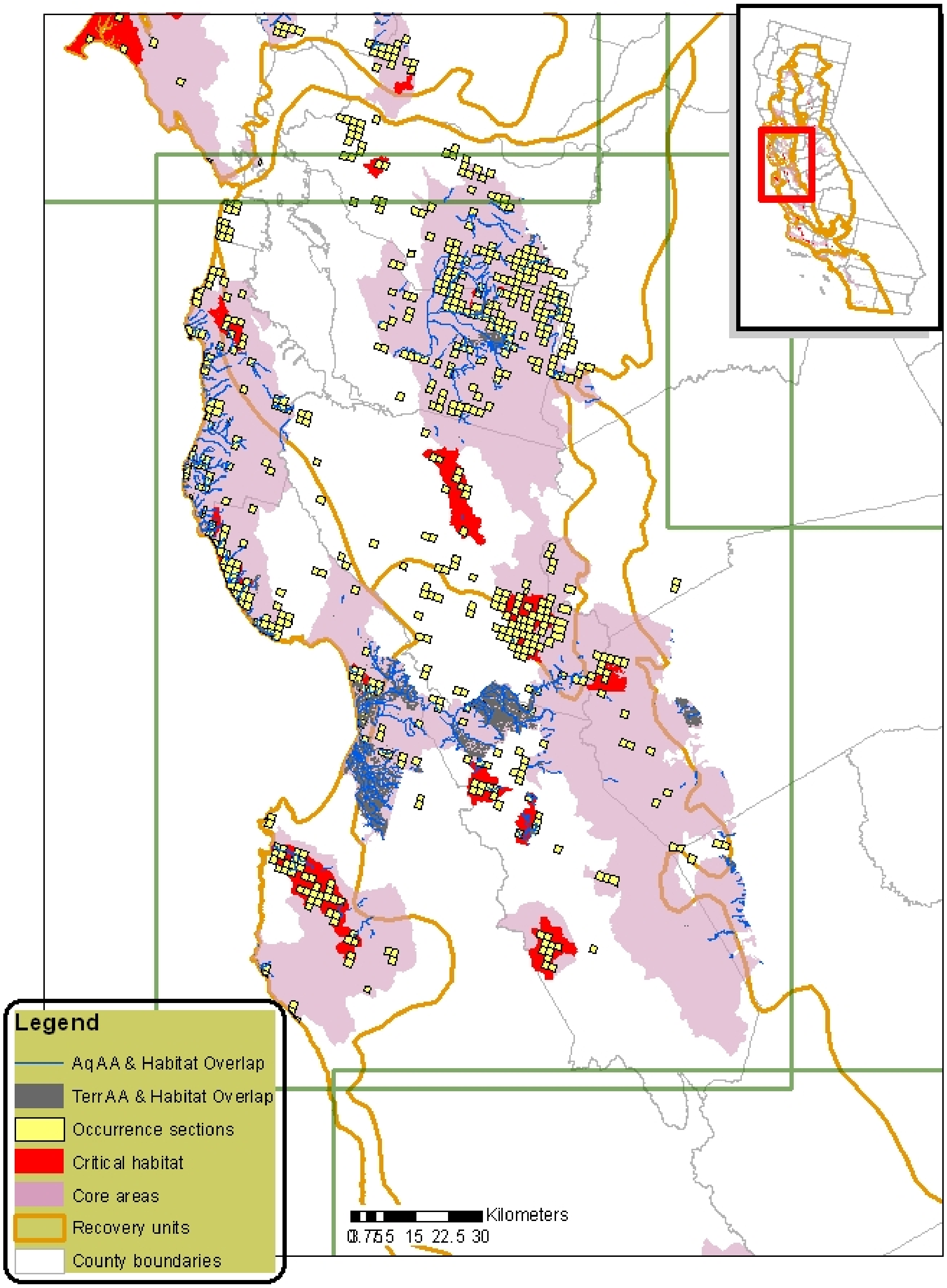
Chloropicrin - Action Area & Habitat Overlap 3



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

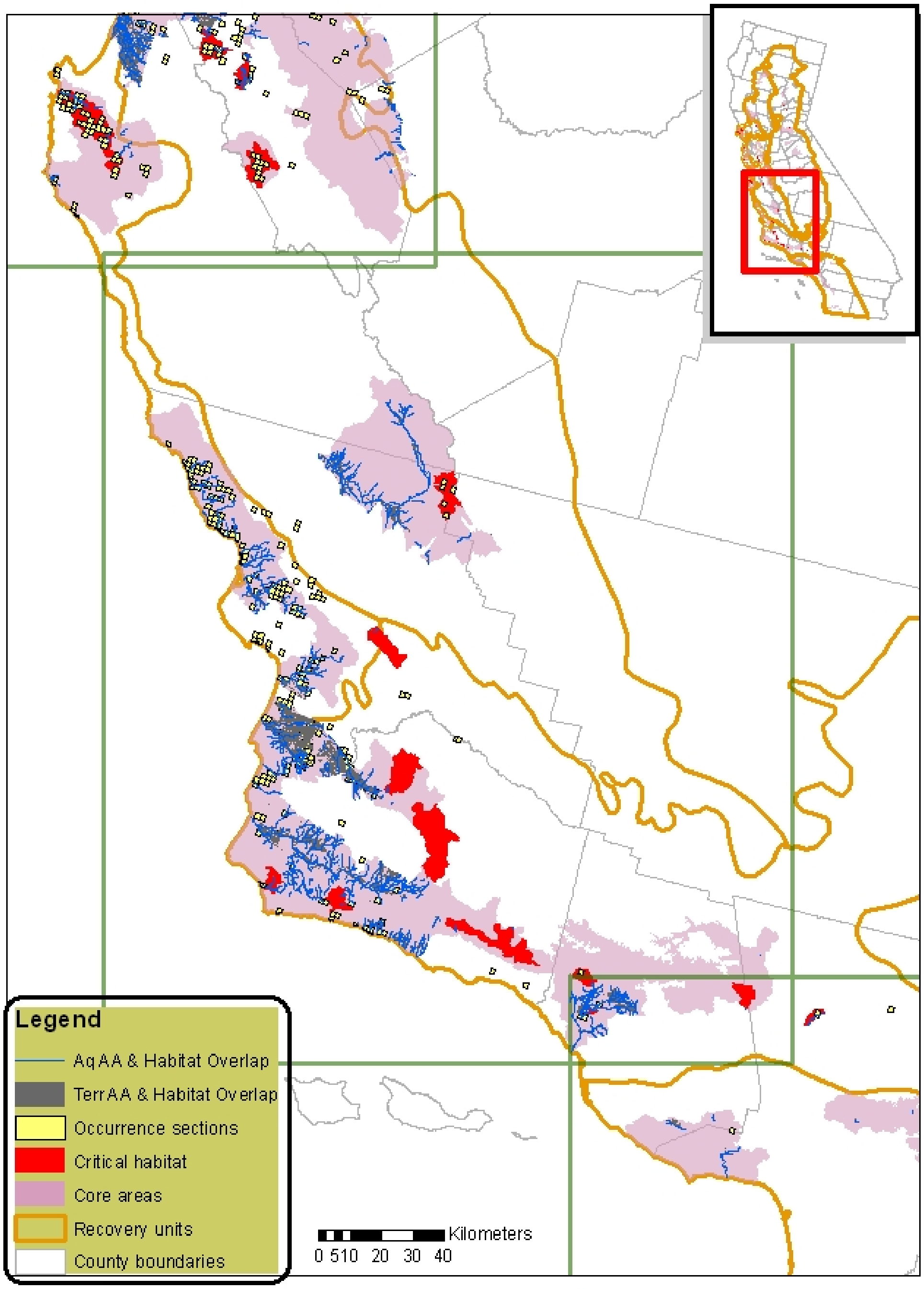
Chloropicrin - Action Area & Habitat Overlap 4



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

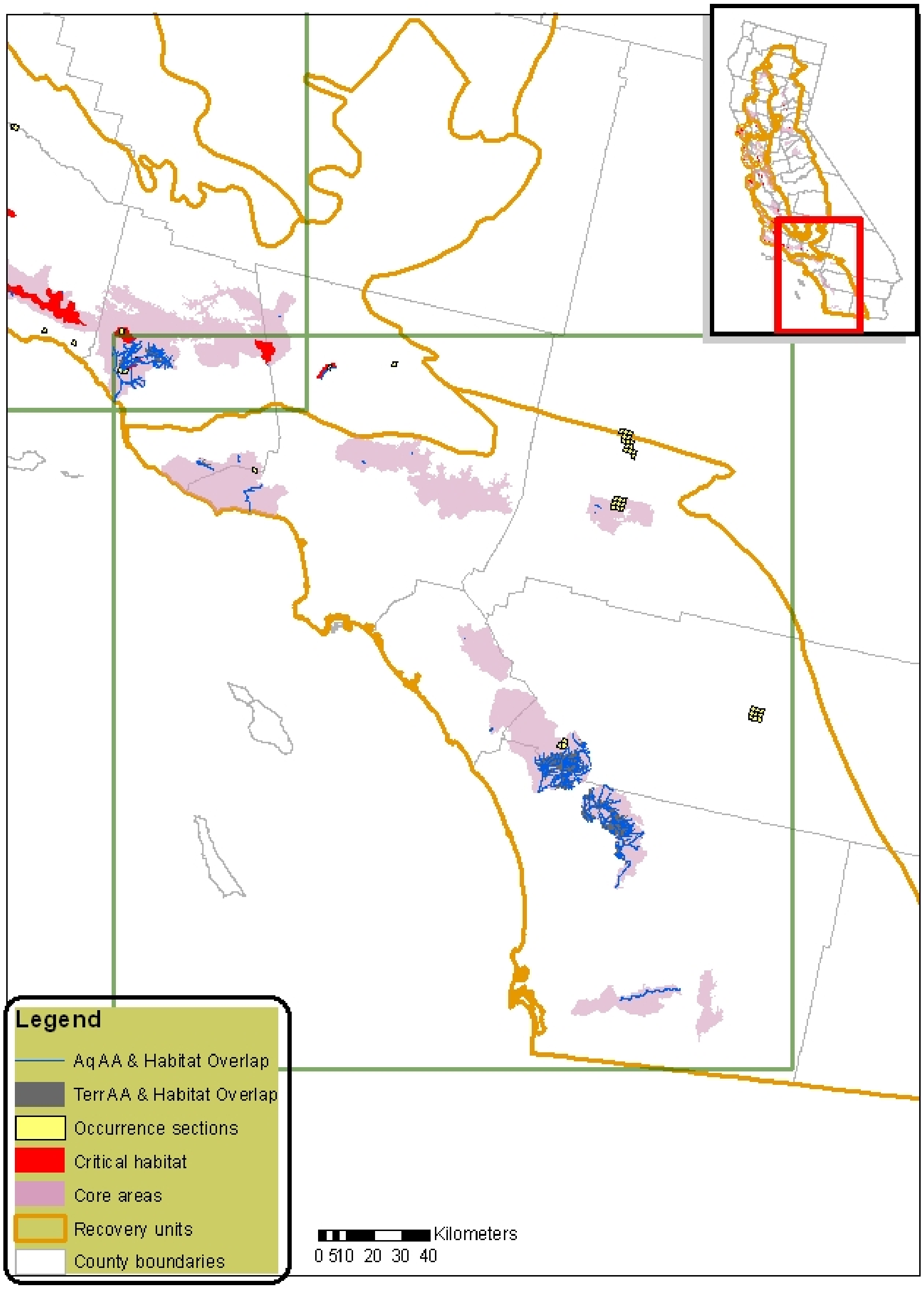
Chloropicrin - Action Area & Habitat Overlap 5



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)

Chloropicrin - Action Area & Habitat Overlap 6



Compiled from California County boundaries (ESRI, 2002), USDA National Agriculture Statistical Service (NASS, 2002) Gap Analysis Program Orchard/ Vineyard Landcover (GAP) National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office of Pesticides Programs, Environmental Fate and Effects Division. July 10, 2007. Projection: Albers Equal Area Conic USGS, North American Datum of 1983 (NAD 1983)